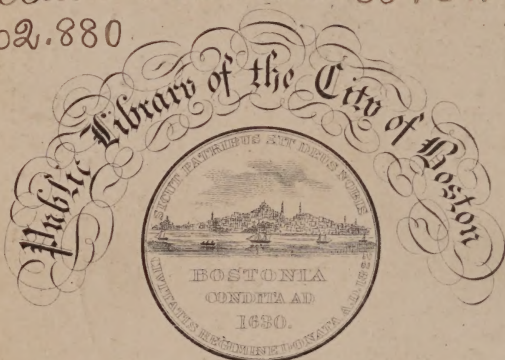


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HORTUS GRAMINEUS

Woburnensis,

OR, AN

ACCOUNT OF THE RESULTS OF EXPERIMENTS ON THE PRODUCE
AND NUTRITIVE QUALITIES OF

DIFFERENT GRASSES,

&c. &c.

USED AS THE FOOD OF THE MORE VALUABLE DOMESTIC ANIMALS,

INSTITUTED BY

JOHN DUKE OF BEDFORD.

ILLUSTRATED WITH FORTY-FIVE COLOURED PLATES.

FOURTH EDITION.

TO WHICH IS (FOR THE FIRST TIME) ADDED,

THE WEEDS OF AGRICULTURE.

THE WHOLE REVISED AND IMPROVED.

BY GEORGE SINCLAIR, F.L.S. F.H.S.

Gardener to his Grace Duke of Bedford.

LONDON:

RIDGWAYS, 169, PICCADILLY.



To,

62880

March 28, 1864



CHARLES WOOD, PRINTER,
Poppin's Court, Fleet Street.

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ADVERTISEMENT,
OR INTRODUCTION,
TO THE FOURTH EDITION.

AMONG the numerous tribes of vegetables which clothe and embellish the earth, no one is more interesting nor more extensively useful than the natural order *Gramineæ*, or family of grasses. In every temperate region the grasses form the general covering of the naked soil, and collectively constitute that verdant turf which yields the most nutritious pasturage, as well as forage for our flocks and herds, for the pampered steed and for the labouring steer.

Although the grasses are most luxuriant and also most abundant in the temperate latitudes, they are also distributed over tropical countries; and though those warm climates present no constantly green hills, or valleys "thick with waving corn," yet such of the grasses as are indigenous there, are of the greatest importance to the half-civilized inhabitants. Their invaluable rice (*oryza sativa*), their prolific maize (*zea mays*) and millet (*panicum miliaceum*), and their equally productive Indian millet (*sorghum vulgare*) are all cereals of the greatest consequence to

the inhabitants of warm countries. And though they have no grasses which can be grazed, except on the narrow margins of rivers, they have an arborescent grass which is otherwise most useful to them, namely, the quick-growing, lofty, and durable bamboo, besides many species of reeds; and above all, the inestimable sugar-cane (*saccharum officinarum*).

The above-named plants are a few of the tropical grasses; and however well adapted to the climate, and variously useful to the natives, and even to far distant lands, they are not to be compared with the hardier species of grasses which adorn and enrich the temperate latitudes, whether considered as pasturable or cereal. The food of man, as well as that of the more useful animals, entirely depends on the produce of our corn fields and our pastures. The improvement of both has always been an especial object in the business and proceedings of rural husbandry, and particularly in the apportionment of meadow to pasture land. The time has been in this country, when providing sufficient forage for live stock in winter was a matter of the greatest difficulty, and great losses were sustained, and many advantages given up, on account of the absolute want of winter fodder. Old turf, suitable either for grazing or for the scythe, was supposed to be a *creation of centuries*; and that a farmer who wished to lay down a meadow in his youth, must see the end of his "threescore years and ten" before he could possibly possess a piece of pasture capable of keeping a score of sheep, or a couple of cows.

So much was the want of grass-land felt among

arable farmers in times past, that the tenantry of it was eagerly sought, its value was consequently highly prized, heavy fines were imposed for breaking it up; the banks of rivers were usually made *commonable*, in order that the surrounding farmers might each have a share; and these meadows were in many cases irrigated, in order to increase still more the scanty stock of winter fodder.

These privations, so long and so severely felt by British farmers in the early part of the last century, did not escape the notice of their scientific friends, more especially botanists. The latter considered whether any summer-growing plant could be sown upon arable land, and which could also be *hayed* and ricked for winter consumption. Several were suggested and approved; and soon after, the clovers, lucern, saintfoin, and vetches appeared in every agricultural district of the kingdom. A considerable accession of live stock on every arable farm soon followed the introduction of those excellent forage plants; and the stock of both sheep and black cattle has been subsequently still more augmented, since the introduction of turnip, beet, &c. into field cultivation.

Nor did botanists neglect to investigate the various species of grasses which were found in almost every pasture or meadow. Some grass-land was more celebrated for its fattening qualities than others; and it became an interesting question, to know whether the superior quality of the herbage was derived from the land, or contained in the species of grass which was most prevalent in the turf. Although the superior

quality of milk, butter, and cheese, as well as the quick fattening of depastured animals, is usually ascribed to the superior qualities of the land, yet it appeared to botanists, as well as to many intelligent farmers, that there really was much difference in the nutritive properties of the various grasses; and they therefore (and very naturally) concluded, that if these best sorts were known, collected, cultivated, and seed saved from them in sufficient quantity, productive permanent meadow or pasture might be created in a few years without risk of disappointment.

Many botanists had studied grasses with the sole view of arranging them botanically. Among the authors who have written descriptions and given names to the species, Caspar Bauhin is one of the earliest; and within our own remembrance the names of Cavanilles, Curtis, Schrader, Aiton, Smith, Host, Vahl, Withering, &c. have all added materially to our stock of knowledge relative to this useful tribe of plants.

While these botanists were pursuing their studies, glimpses of light, respecting the grasses, were from time to time elicited and taken advantage of by farmers, who, becoming slowly sensible of the bad practice of trusting to the sweepings of hay-lofts for their grass seeds, readily purchased pure seed, wherever it was to be had. Ray-grass (*lolium perenne*) was one of the first in the market, and this happened chiefly from the ease with which the seed was collected. Next we had the meadow cat's-tail (*phleum pratense*), and soon afterwards the cock's-foot (*dactylis glomerata*), and some few others.

These were progressive steps towards a better knowledge of the grasses, and the specific value of some few of them. But of the comparative value of all those not in cultivation (and they were numerous), we were still very much in the dark.

Luckily, however, soon after the commencement of the present century, it occurred to his Grace the Duke of Bedford, whether or not it was practicable to ascertain by chemical analysis the nutritive properties of the grasses. His Grace, it appears, applied to the then eminent professor of chemistry, Sir Humphry Davy, on the subject, and received a favourable answer, together with an offer of assistance, in ordering a proper apparatus, and full directions for carrying on the various operations, to fulfil as far as possible the patriotic wishes of his Grace.

At this time, the Duke of Bedford possessed at Woburn Abbey one of the most extensive and complete grass gardens in the kingdom. This garden was arranged, and the different species selected, and cultivated for a requisite number of years, by his Grace's gardener, the late Mr. George Sinclair, F.L.S. &c. who, to a natural love of botanical as well as general science, added intelligence, and a steady perseverance in accomplishing whatever his duty imposed.

In him the Duke found a willing and most competent agent, in carrying into execution, under the directions of Sir Humphry Davy, his Grace's design of analyzing the grasses, and which task he performed with signal credit to himself, and much to the satisfaction of his noble patron.

As the results of this chemical investigation were

necessarily connected with the specific descriptions of the different kinds of forage plants, cultivated or uncultivated, which were submitted to the ordeal; and as the whole scrutiny and experiments, both in cultivating and analyzing the plants, were undertaken by the Duke for the express purpose of benefiting the agricultural interests of the kingdom; keeping an account of the proceedings in the library of Woburn Abbey, would have defeated the object which his Grace had mainly in view; and therefore it was determined that Mr. Sinclair should compile the whole in one splendid volume, to be published under the auspices of the Duke himself.

The original folio edition contained not only the botanical descriptions of the different grasses, but also actual specimens, and perfect and imperfect seeds of the same, together with their nutritive properties, both as grass and hay; and how far useful to the agriculturist, or fit to be admitted into permanent pasture. Besides this, the work contains much valuable information on the nature of soils, the grasses or other plants most suitable for them, and full directions for laying down or renewing worn-out grass land: to which are added many general but highly useful observations, interesting to every one engaged in the cultivation of land. The whole book indeed was highly creditable to its late lamented author, who was cut off in the prime of life, and in the midst of his usefulness as a nursery and seedsman, in the firm of Cormack and Co., New Cross, Kent. The volume, however, will always remain a monument to the honour of the patriotic nobleman whose liberality

called it forth, and a lasting memorial of its author as an agricultural botanist.

The expensive style in which the first edition of the work was got up, placed it entirely out of reach of those, to whom the information it contains would have been most useful; and, therefore, two royal 8vo. editions were subsequently published; but, unfortunately, the greater part of these impressions was destroyed by fire, at Mr. Moyes's, printer, in 1835, so that the book is nearly out of print.

The proprietors therefore resolved to get up the present reprint of the work on a smaller scale, and at a lower price, in order to meet, as they hope, a more extensive demand. And as this fourth edition contains all the essentials and excellencies of the original copy, with all necessary corrections which the lapse of time or change of nomenclature renders expedient; and as its reduction in size and price will bring it fairly within reach of those (the young farmers of Britain) for whom it was originally published; the proprietors trust that what they have done in issuing this reprint will meet their approbation. Especially because, not only are descriptions given of all the best grasses, and other forage plants tested and recommended by the author; but also a corrected catalogue, with descriptions of the "Weeds of Agriculture," a small work completed by the same author a few years before his death.

The first folio edition of the "HORTUS GRAMINEUS WOBURNENSIS" was inscribed to his Grace the Duke

of Bedford, and gave the author opportunity to express his grateful acknowledgements to his noble patron and employer, for his Grace's "most liberal, kind, and unwearied encouragement, bestowed on an humble individual, anxious to prove himself worthy of the trust reposed in him, while engaged in gaining and communicating useful knowledge in a branch of one of the most important of the arts."

The author next, in an advertisement, acknowledges his obligations to those of his friends, from whom he had received advice and assistance in the prosecution of his laborious undertaking. Among these are the names of Sir Humphry Davy; Thomas Greg, Esq. of Coles, Hertfordshire; James Sowerby, Esq. F.L.S.; Mr. Andrew Wilson, of the Park Farm, from whom he received the chief of his information relative to breaking up old and laying down new pastures; Messrs. Thomas Gibbs and Co., Seedsmen to the late Board of Agriculture, for collections of seeds, soils, and much useful information on the general subject. He also gives the names of authors from whom he has taken extracts or descriptions.

The following are extracts from the first Introduction, *viz.*

Distinguished agriculturists agree in opinion, that the knowledge of the comparative merits and value of the different species and varieties of grasses, and best mode of cultivating them, is very much behind that of the other branches of practical agriculture.

Out of two hundred and fifteen species of grass which may be cultivated in this country, many of

which differ from each other in value, two only have been cultivated separately, to any extent. This may appear extraordinary; but there have been difficulties in the way.

Grass, says Professor Martyn, vulgarly forms *one* idea; and a husbandman, when he is looking over his enclosure, does not know that there are three hundred species of grass, of which thirty or forty may be at the moment under his eye. They have scarcely had a name, besides the general one, until within these twenty years; and the few particular names which have been given, are far from having obtained general use; so that we may fairly assert, that the knowledge of this most common and useful tribe of plants is yet in its infancy. Of the one hundred and thirty-three distinct species and varieties of grass, natives of the British Isles, many are of no value to the farmer, while others constitute the foundation of his riches, as they are the staff of life to the most valuable domestic animals. Now though they are very different in value, they are mostly similar in appearance; and therefore recourse must be had to the botanical distinctions which are the least subject to change. But these being often minute, the investigation of them is often perplexing even to botanists; and consequently, to those who know nothing of that science, their specific distinctions must always be a matter of difficulty. But allowing that the different grasses were easily distinguished, and that farmers were in possession of the seeds, the length of time which would be required to prove their relative value, by the usual way of experimenting on a farm, would

be so tedious and expensive as to prevent such trials, especially if the results were doubtful.

The labours of botanists, and the exertions of agricultural societies and patriotic individuals in the same cause, have raised a spirit of inquiry which ultimately must produce beneficial effects on practical agriculture. A hope of promoting these views, was the motive that induced his Grace the Duke of Bedford to institute the following series of experiments :—

Spots of ground, each containing four square feet, in the garden at Woburn Abbey, were enclosed by boards in such a manner, that there was no lateral communication between the earth enclosed by the boards and that of the garden; the soil was removed in these enclosures, and new soils supplied, or mixtures of soils were made in them, to furnish as far as possible to the different grasses those soils which seemed most favourable to their growth; a few varieties being adopted, for the purpose of ascertaining the effects of different soils on the same plant. The nature of these soils was accurately ascertained by analysis; the process employed, was that recommended by Sir H. Davy. Upwards of two hundred species and varieties of grass were planted or sown at the proper seasons; the different species were cut at certain stages of growth, and the weight of produce carefully ascertained; the particular seasons at which the different species attained to the greatest degree of perfection, were attentively observed, as likewise the time of flowering, and the period of perfecting the seed. Their comparative

value, therefore, in regard to produce, and the particular seasons at which it was in perfection, with the kind of soil most favourable to their growth, and the peculiar habits of the different species, were, by these means, satisfactorily ascertained; but the comparative degree of their nutritive powers was still to be determined.

To compass this was the chief object: and to arrive at something like certainty on this point, the Duke resolved to obtain it by a simple chemical process, as recommended by Sir H. Davy, and the results were highly satisfactory.

The process is simply this:—Equal quantities of the different grasses, either in a green or dry state, are submitted to the action of hot water, till all the soluble parts are taken up. The liquor is then separated from the woody fibre by means of blotting paper: it is then evaporated to dryness. The product, or solid matter, is the nutritive matter of the grass or hay. Thus the comparative value of two kinds of grass or two kinds of hay are found; or the properties of any given one. Sir H. Davy has shown that the nutritive matter of grasses consists, for the most part, of five distinct vegetable substances, *viz.* mucilaginous, saccharine, albuminous, bitter extractive, and saline matters: and that it is probable, that the excellence of the different articles as food, will be found in a great measure proportional to the quantities of soluble or nutritive matters they afford. But still these quantities cannot be regarded as absolutely denoting their value: albuminous or glutinous matters have the characters of animal substances;

sugar is more nourishing, and extractive less nourishing, than any other principles composed of carbon, hydrogen, and oxygen; certain combinations of these substances, likewise, may be more nourishing than others.

One species of grass is distinguished from every other by its properties, and by the number, situation, proportion, and colour of the different parts of its structure. Of these parts, the most obvious are, the root (*radix*): the straw, stem, or culm (*culmus*): the leaves (*folia*): the flower or husks (*flos vel gluma*): and the seed (*semen*). The figure of these parts varies in different species; it is therefore necessary that each should have a name, by which it may be distinguished from every other.

The varieties of the root are, fibrous, or creeping, or bulbous.

The varieties of the stem are, simple, branched, erect, straight, ascending, decumbent, procumbent, creeping, naked, rough, cylindrical, compressed, two-edged, four-cornered, knee-jointed, bulbiferous, that is, bearing bulbs. For the most part the straw or stem is entire, with the flowers crowded together on a spike or ear at the top, as in wheat; or much divided at top, into a panicle, the flowers or grain being borne on slender foot-stalks, as in oats.

The leaves of grasses are all quite simple, or undivided, and therefore offer but few characters of distinction, except in size, situation, or surface covering.

Sheath-scales or stipules of grasses are small membranaceous expansions, attached to the inner sides of

the leaves; they have their origin at the top of the vagina, or the point where the blade of the leaf first diverges from the stem.

The curious structure of the flowers of grasses is sufficient to attract notice, independent of their use in distinguishing with certainty the species and varieties. Inflorescence, or the manner in which the flowers are supported and disposed on the culms, affords the most obvious characters of distinction: it is of two kinds, the spike, and the panicle already alluded to.

The flower consists of five distinct parts, the calyx or outer husks (*gluma*), the inner husks (*corolla*), the stamens or male parts (*stamina*), the pistil or female parts, and the germen or rudiment of the future seed. The calyx, or outer husks, contains the flowers, and afterwards the seed. It is either of one, two, or many valves, and is described accordingly. The corolla, or inner husks, contains the stamens, style, and germen: when the seed is perfected, the husks generally enclose and adhere to it. This and the calyx constitute the chaff of oats, wheat, &c.

The stamens are the male parts of the flower. Each consists of three parts, the filament, the anther, and the pollen or flower-dust. The filament is a slender thread which supports the anther. The anther is a cellular body of a linear figure, generally cloven at both ends; it contains the pollen, which is essential to the production of the perfect seed. The anthers are various in colour, as white, yellow, or blue.

The pistil is the female part of the flower, and

likewise consists of three parts, the germen, the style, and the stigma. The germen is situated at the bottom of the flower, and is the rudiment of the future seed. The style consists of two-feather like processes, seated on the top of the germen, and reflexed; the stigma is the feathered division of the style.

The seeds of most grasses are covered or enclosed by the husks, which was formerly the corolla; in some of them the seed is naked, or so loosely covered by the husks, that the latter separate from the grain in cleaning.

The general character of the grasses is summed up in the following words. The stem or straw is hollow and jointed; the leaves are long, slender, and entire, sheathing the straw or stem for some length, and in number, equal to the joints of the straw; the flower consists of one or two membranaceous husks, which bears but one seed, and the seed when rising from the soil appears with only one lobe, or seed-leaf. Every plant, therefore, possessing these peculiarities of structure, is a proper species of grass; hence the proper grasses are called a natural order of plants.

On the subject of soils, the author has the following remarks. As every different soil produces grasses peculiar to itself, and as no other kinds can be established or cultivated upon it, without first changing its nature, to resemble that which produces the kinds of grasses we wish to introduce; it becomes an important point, in making experiments on different species, and in stating the results, to determine with sufficient accuracy the nature of the soil

or soils employed, and to describe them accordingly. In many instances, where experiments have been made on the produce of plants, this very essential point has been disregarded; it is to this only we can look for a satisfactory reason to reconcile the discordance of results obtained from experiments, made on the same kind of plant by different persons, equally competent to execute the trials with care and accuracy. From the same source will be found to proceed the difference of opinion, respecting the impoverishing effects of different plants on the soil. Some plants exhaust the soil more than others; and though the preparation and the manure bestowed be the same in two cases, yet a specific difference in the nature of the soils, will give different results as to their produce.

The terms adopted to denote different soils, have been used without precision. The term *loam*, for instance, is defined by one to be a fat earth or marl, and by others, to be a mixture of clay, sand, and calcareous earth, without stating the proportions. In general, on referring to books on agriculture and gardening, we are directed to a hazel loam, a brown loam, clayey loam, or to a hungry sandy soil, bog soil, peat earth, garden mould, &c.; but for want of proper definitions of these terms, it is perplexing or nearly impracticable to determine which kind of soil is meant.

The method of determining the nature of soils by chemical analysis has been so simplified, that it is now in the power of every practical person to ascertain with facility the qualities of any kind of soil,

and to describe the same without any risk of being misunderstood.

Sir H. Davy states the proportion of sand and impalpable earthy matter, to which the terms usually adopted should be limited. The term sandy should never be applied to any soil that does not at least contain seven-eighths of sand; sandy soils, that effervesce with acids, should be distinguished by the name of calcareous sandy soil, to distinguish them from those that are siliceous. The term clayey should not be applied to any land, that contains less than one-sixth of impalpable earthy matter, not considerably effervescing with acids. The word loam should be limited to soils containing at least one-third of impalpable earthy matter. A soil to be considered as peaty, ought to contain at least one-half of vegetable matter. These may be considered as the generic characters of soils, and determined by a very simple process, that of washing the impalpable earthy matter of the soil from the sandy portion, and by drying and ascertaining their respective weights, when the application of an acid shows whether it belongs to the calcareous [limey] or siliceous [flinty] kind of soil.

It may be observed here, that this test only shows the constituents of the soil, not its value as fertile or unfertile; as the same constituents may be either rich or poor, according as they are managed.

The author next gives his analization of twelve different sorts of soils used in his experiments, with observations, as follow:—

1. *Poor siliceous sandy soil.*
2. *Siliceous sandy soil,*

or hungry sand. Observation. This last was comparatively barren, without frequent applications of large portions of manure, and which had only a transient effect: was permanently improved by the application of tenacious clay. 3. *Heath soil, or black siliceous moor soil.* 4. *Rich siliceous sandy soil.* Ob. This, when on a clayey subsoil, produced large crops for two successive seasons, but afterwards required a regular supply of manure. When the subsoil was porous, or consisted of gravel, the produce was very inferior. It is properly a hungry soil, and requires an addition of clay and calcareous earth, to render it permanently fertile. 5. *Sandy loam, or Brompton common loam.* Ob. This soil affords an illustration of the term *loam*, in its general acceptation among husbandmen and gardeners in the neighbourhood of London. 6. *Rich black clayey loam.* 7. *Clayey loam.* 8. *Tenacious clay.* 9. *Rich alluvial soil, partly formed by depositions from flowing water.* Ob. Of all the soils employed in the experiments, this one was the most productive: it was upon a porous subsoil; all the superior grasses flourished here in an extraordinary degree; it therefore offers data whereby to judge of soils most suitable for grasses. 10. *Vegetable mould.* 11. *Active peat, or fertile peat moss.* 12. *Inert peat, or barren peat moss.*

Beds of these soils (No. 2 and No. 8 excepted) were arranged in the order in which they have been named above. Seeds of all the grasses peculiar to each soil, were sown on distinct spaces of each bed. The seeds vegetated on all the soils, except on No. 12, which remained completely barren. In the ensuing

season, it was remarkable to see the different degrees of luxuriance exhibited by the same species of grass on different soils. The superior grasses formed nearly a convex ridge; beginning at the poor siliceous sand, No. 1, where they were most diminutive, they gradually increased in luxuriance, till they reached the bed of alluvial soil, No. 9, and afterwards decreased in quantity of produce, till they terminated at the barren peat, No. 12. It is right to observe, however, that after the second year, this order of luxuriance did not continue in the same proportion. The rich siliceous sand decreased annually after the second year. The produce of the sandy loam and clayey loam continued much the same; but the rich alluvial soil, and the rich clayey loam, increased in the quantity of produce till the fifth year, and have since continued, with but a trifling diminution, though no manure has been applied.

The principal use of this experiment was to show, not only the various degrees of fertility of each soil respectively, but also to show how far the inferior descriptions might be improved by an intermixture of those which were superior. On this part of the subject, the author has entered into some elaborate calculations, to show the necessary extent and cost of improving an acre of poor siliceous sand, by laying upon it a dressing of tenacious clay; thus changing it into a sandy loam when thoroughly incorporated; a result which is perfectly practicable, but rarely executed, on account of the expense, labour, and loss of time which would be incurred.

The foregoing extracts are chiefly from the introduction to the first folio edition. The second royal 8vo. edition was published in 1824, and dedicated to Thomas William Coke, Esq. M.P., now Earl of Leicester and Holkham. From the introduction to this last, we extract what follows:—

In the original copy of this work, the catalogue of proper grasses contained upwards of *three hundred and twenty* species; but in this (second) edition, the number of distinct species of the proper grasses enumerated, amounts to about *one thousand five hundred*. This increase has arisen from information gained from new intermediate publications, but chiefly from the authors researches and inquiries in some of the richest and most fattening pastures in Devonshire, Lincolnshire, and in the Vale of Aylesbury. The proportions in which the different grasses and plants were found combined in these pastures, were carefully examined and ascertained; besides, pieces of the turf were transplanted into the grass-garden, where their properties were studied and recorded, and the results introduced into the new edition, together with directions for collecting seeds; new mode of returning tillage land to pasture, transplanting turf, &c. There is also an announcement, that the work has been translated into the German language, by Mr. Schmidt, and that the King of Wirtemberg was graciously pleased to allow it to be dedicated to his Majesty.

In this said Edition, numerous lithographed figures are given of the plants, and also of their seeds separately. These engravings very much swelled the

size and cost of the book, thereby rendering it less useful than it otherwise would have been. In the present edition, these expensive illustrations will be reduced in number, though not in utility; as every necessary illustration will be retained of all the best grasses, together with their dissections on the same plate, to which all requisite references will be appended.

HORTUS GRAMINEUS

Uoburnensis.

CHAPTER I.

THE enumeration, identification, description, and investigation of the nutritive properties of the natural order of grasses as the food of the more valuable domestic animals, were the grand objects the author had in view in composing this valuable volume. He commences the work by relating the orders, the wishes, and suggestions of his noble Patron relative to the undertaking; his own motives and duty inducing him to engage in the task; together with an account of the means he possessed for enabling him to prosecute the laudable design. These particulars have already been briefly detailed in our introduction. We now enter upon the body of the work, in which full descriptions, both botanical and popular, are given of the grasses, and other forage plants which come within the scope of the author's plan, and which he considered more particularly interesting to agriculturists in general. And in order to show what will be minutely described hereafter, we will first give his general list of grasses, *viz.*

SECT. I.—*Grasses with three stamina, one style, calyx multivalve, or an involucre.*

LYGEUM. Hooded mat-weed. Generic character; *flowers* produced in pairs; *spathe* convoluted, of one leaf; *seed-vessel* a nut two-celled, two-seeded, villose.

spartum, perennial. Rush-leaved Spanish mat-weed.

CORNUCOPIÆ. Horn of plenty grass. Hooded cornucopia. Generic character: *involucre* of one leaf, cup-

shaped, many-flowered, crenated ; *calyx* two-valved, equal ; *corolla* one-valved ; *seed-vessel*, none, the corolla encloses the seed, which is flat on one side and convex on the other.

CORNUCOPIÆ *cucullatum*, annual ; *spike* awnless, cup-shaped, crenate.

POMMEREUELLA. Generic character : *spikelets* sitting, two-rowed ; *calyx* two-valved ; three-six-flowered, flowers short ; *corolla* two-valved, the inferior one with four teeth, segments bristled, awn dorsal, flexuose from between the smaller segments ; *spikes* simple, culms branching, seed smooth.

cornucopia, *per.* Nat. East Indies.

monoica. Nat. East Indies.

CENCHRUS. Serpent-grass. Generic character : *involucrum* enclosing from three to five spikelets, often double, exterior furnished with stiff bristles, interior, one leaf, multifid ; *segments* lanceolate, nearly equal ; *calyx* two-valved, two-flowered ; inferior *florets* masculine, superior bisexual ; *glumes* of the corolla two, lanceolate, acute, awnless ; *germen* marginate ; *spike* compound.

tribuloides, *ann.* caltrop serpent-grass, nat. of Virginia and the sea coasts of Florida.

echinatus, *ann.* hedgehog serpent-grass, nat. Arabia.

pungens, *ann.* sharp-pointed serpent-grass, nat. of the hot half-inundated plains of Peru, near Guayaquil.

rufescens, *ann.* brown serpent-grass, nat. of Mascar, growing in sands.

ramosissimus, *ann.* branching serpent-grass, nat. of Egypt.

parviflorus, *ann.* small flowered serpent-grass, nat. of Porto-Rico.

setigerus, *ann.* bristly serpent-grass, nat. Arabia.

geniculatus, *ann.* knee-jointed serpent-grass, nat. of the Cape of Good Hope.

muricatus, *ann.* caltrop-like serpent-grass, nat. of the East Indies.

purpurescens, *ann.* purple serpent-grass, nat. of Japan.

CENCHRUS hordeiformis, ann. barley-like serpent-grass, nat. of the Cape of Good Hope.

ovatus, ann. oval-spiked serpent-grass, nat. of the Cape of Good Hope.

tomentosus, ann. woolly serpent-grass, nat. of the Cape of Good Hope.

frutescens, ann. shrubby serpent-grass, nat. of Achaia and Messina, on the sea coast.

Australis, ann. Botany Bay serpent-grass, nat. of New Holland.

calyculatus, ann. glomerate serpent-grass, nat. of the Friendly Isles.

inflexus, ann. inflex branched serpent-grass, nat. of Guiana.

myssuroides, ann. mouse-tail serpent-grass, nat. of the shores of the Pacific Ocean, in sunburnt sands.

pilosus, ann. hairy-leaved serpent-grass, nat. of the province of New Barcelona.

Brownii, ann. Brown's serpent-grass, nat. of New Holland.

marginalis, ann. crisped-leaved serpent-grass, nat. of Guiana.

PENNISETUM. Generic character: *involucrum* many times double; exterior spines unequal, one double the length of the other, interior pinnate—bearded; *spikelets* numerous, from two to five; *calyx* two-valved, valves unequal; *florets*, the inferior unisexual, superior bisexual, sitting; *anthers*, apex naked; *stigma* feathered; *spike* compound, spikelets sitting.

setosum, bien. bristly pennisetum, nat. of India and Rio Janeiro.

purpurescens, per. purple pennisetum, nat. of arid soils in the kingdom of Mexico.

conchroides, ann. ciliated pennisetum, nat. of the Cape of Good Hope.

orientale, per. eastern pennisetum, nat. of Galatia.

violaceum, per. violet pennisetum, nat. of Senegal.

helvolum, per. nat. of the East Indies.

uniflorum, per. one-flowered pennisetum, nat. of the more temperate plains of New Andalusia.

Italicum, ann. Italian.

PENNISETUM *compressum*, ann. flat-stalked pennisetum, nat. of New Holland.

SECT. II. *Grasses with two stamina, one style, and the calyx one-flowered.*

NARDUS. Mat-grass. Generic character: *corolla* two-valved; *calyx* wanting; *seed* linear, oblong.

stricta, per. upright mat-grass, indig. Flowers in June and July.

filiformis, ann. slender mat-grass, nat. Portugal. Flowers in June.

aristata, ann. See *Rottboellia monandria*.

Thomæa, ann. imbricated, nat. of Malabar.

ORYZOPSIS. Spurious rice. Generic character; *calyx*, two-valved, one-flowered; husks membranaceous, coriaceous, hard, a little longer than the corolla; *corolla* two-valved, inferior husk with a villose apex, awn-jointed, superior valve entire; *nectary*, two appendages the length of the germen; *style* simple; *panicle* rather simple, loose.

asperifolia, rough-leaved spurious rice, nat. of the mountainous tracts near Quebec.

ERIOPHORUM*. Cotton-grass. Generic character: *calyx* one valve, one-flowered; *flowers* in an imbricated spike, exterior flower generally barren. *Corolla* wanting, if the calyx valve be not considered such. *Seed* three-cornered, furnished with downy hairs.

alpinum, per. alpine cotton-grass, indig. Flowers in April and May.

vaginatum, per. sheathed cotton-grass, indig. Flowers in April and June.

* The genus *Eriophorum* belongs to the natural family of Cyperaceæ: it is here placed in company with the proper grasses, because I have observed our English species eaten by cows, oxen, and sheep, in common with those species of proper grasses with which they happen to be combined, while the species of other genera of cyperaceæ growing on the spot were rejected; — not a Botanical reason certainly, but an Agricultural one, which the learned and indulgent Botanist will here, I hope, excuse.

ERIOPHORUM *capitatum*, per. headed cotton-grass, indig.

Flowers in June and July.

gracile, per. three-cornered or slender cotton-grass ; indig.

Flowers in May.

angustifolium, per. narrow-leaved cotton-grass, indig.

April and May.

polystachion, per. broad-leaved, indig. May.

pubescens, downy-stalked cotton-grass, indig.

Virginicum, per. Virginian, nat. Canada.

strictum, per. upright.

SECT. III.—*Grasses with two stamina, two styles, calyx containing one flower.*

ANTHOXANTHUM. Vernal grass. Generic character :

calyx, husk of two valves, containing one flower ; *corolla*,

husk two valves, awned ; *seed-vessel*, the husks of the

corolla adhere to the seed ; *seed* nearly cylindrical,

tapering at each end.

odoratum, per. sweet-scented vernal grass, indig. Flowers

in April and May.

amarum, per. bitter, nat. Morocco. Flowers in May.

crinitum. See *Agrostis crinita*.

alpinum, per. alpine sweet-scented vernal grass, nat. (?)

April and May.

SECT. IV.—*Grasses with three stamina, two styles, one flower in each calyx ; flowers bisexual, corolla of one valve only, except Aristida, with a second valve of the corolla very inconspicuous.*

TRICHODIUM. Single-husked bent. Generic character :

calyx two-valved ; *corolla* one valve, smaller than the

calyx, awned or awnless, furnished with a tuft of hairs

on one side of its base ; *seed* covered by the husk.

caninum, per. brown, indig. July.

Kitaibilibi, per. slender, sub-alpine places, Pannoni.

niveum, per. snowy, indig. June.

muticum, per. awnless, indig. July.

alpinum, per. alpine ; nat. Germ.

TRICHODIUM *rupestre*, per. rock, indig. June.
neglectum, per. neglected, nat. dry grassy places.
flavescens, per. yellow, nat. middle Alps of Europe.
glaucinum, per. glaucous, nat. Anjou.
rubrum, per. red, nat. Lapland.
hybridum, per. spurious, nat. Switz.
decumbens, bien. decumbent, nat. America.
laxiflorum, bien. loose-flowered, nat. America.
elegans, ann. nat. France.
algidum, ann. nat. Greenland.
salmanticum, ann. nat. Spain.

ALOPECURUS. Fox-tail grass. Generic character: *calyx* two-valved, one-flowered, valves mostly united at the base; *corolla*, one valve, with an awn proceeding from the base; *styles* combined.

Tauntoniensis, per. Taunton's fox-tail grass, nat. ? April, May, June, July, August.

arundinaceus, per. reed-like fox-tail, indig. May, and all summer.

pratensis, per. meadow fox-tail, indig. May.

geniculatus, per. jointed, indig. June.

var. *bulbosus*, per. bulbous-jointed.

bulbosus, per. upright bulbous-rooted, indig. June.

nigricans, per. blackish, nat. Wolgam.

fulvus, per. tawny-coloured, indig.

Capensis, per. Cape, nat. hills round Cape Town.

Alpinus, per. Alpine, indig. April and May.

antarcticus, per. antarctic, nat. Straits of Magellan.

agrestis, ann. slender, indig. June and July.

ramosus, ann. branching, nat. America.

utriculatus, ann. inflated, nat. Germany. Flowers in May and June.

cornucopioides, ann. horn-of-plenty-like fox-tail.

subaristatus, ann. small-awned, nat. Canada.

echinatus. per. hedgehog fox-tail grass, nat. Cape of Good Hope; rare.

ventricosus, ann. ventricose-sheathed, nat. France.

latifolius, ann. broad-leaved, nat. Tobago.

villosus (?), ann. hairy, nat. Switzerland.

ALOPECURUS *lanatus*, *per.* woolly, nat. summits of Mount Olympus.

ovatus, *per.* oval, nat. Islands of the South Sea.

ARISTIDA. Awned grass. *Chataria*, *Arthraterum*, et *Aristida*. Generic character: *calyx* two-valved; *corolla* outer valve generally hirsute at the base, terminated with awns (three), spreading; *inner valve* lanceolate, very minute or wanting; *seed* filiform, naked.

Adscensionis, nat. Island of Ascension. Linn. Spec.—wherein it is stated to constitute a third part of the whole Flora of that island, there being besides this plant only two others, viz. *Euphorbia organoides*, and *Sherardia fruticosa*. *Chataria Adscensionis*.

Americana, nat. Jamaica.

plumosa, *per.* feathered, nat. Jamaica.

arundinacea, *per.* reed-like, nat. E. Indies.

gigantea, *per.* lofty, nat. Island of Teneriffe.

hystrix, *per.* hedge-hog, nat. Malabar.

purpurescens, *per.* purple, nat. Carolina.

gossypina, *per.* cottony, nat. Carolina.

oligantha, *per.* distant solitary-flowered, nat. America.

stricta, *per.* upright, nat. Carolina.

setacea, *per.* bristly, nat. Malabar.

vestita, *per.* nat. C. G. H.

pallens, *per.* nat. America.

Luzonensis, *per.* Lutzon, nat. Isle Lutzon.

stipæformis, *per.* stipa-like, nat. C. G. H.

divaricata, *per.* nat. Mexico.

capillacea, *per.* hair-like, nat. America.

Lamarckii, *per.* Lamarck's, nat. Senegal.

cærulescens, *per.* blue, nat. Barbary.

festucoides, *per.* fescue-like, nat. Senegal.

depressa, *per.* depressed, nat. Malabar.

Antillarum, *per.* nat. Antilles.

Capensis, *per.* Cape, nat. C. G. H.

interrupta, *per.* interrupted, nat. Mexico.

elatior, *per.* tall, nat. S. Amer.

racemosa, *per.* branching, nat. Island of St. Helena.

humilis, *per.* dwarf, nat. S. Amer.

- ARISTIDA *setifolia*, *per.* bristly-leaved, nat. S. Amer.
bromoides, *per.* broom-like, nat. S. Amer.
coarctata, *per.* crowded, nat. S. Amer.
spadicea, *ann.* nat. S. Amer.
recurvata, *per.* nat. Island St. Thomas.
calycina, *per.* nat. N. Holl.
ramosa, *per.* nat. N. Holl.
dichotomus, *bien.* nat. Carolina.
pungens, *per.* pungent-leaved, nat. Sfax Desert.
stipoides, *per.* nat. N. Holl.
hygromatricum, *per.* nat. New Holland.
ciliata, *per.* ciliated, nat. Barbary.
murina, *per.* wall awned-grass, allied to *Hordeum murinum*.
rigida, *per.* rigid, nat. Philippine Isles.
laxa, *per.* loose, nat. Philippine Isles and Montevideo.
longe spicata, long-spiked, nat. Carolina.
vagans, *per.* divaricated paniced, nat. N. Holl.
ternipes, *per.* alternate branched, nat. Panama.
elegans, *per.* elegant, nat. S. Amer.
rigescens, *per.* stiff-leaved, nat. E. Indies.
uniplumis, *per.* one-feathered, nat. C. G. H.
congesta, *per.* nat. Cape of Good Hope.

KNAPPIA. Knapp's Grass. Generic character: *calyx* one-flowered, two-valved, truncated; *corolla* like hairs, united at the base, parallel, enclosing the fructification.
agrostidea, *ann.* bent-like Knapp's grass, indig. May.

SECT. V. Grasses with three stamina, two styles; *calyx* one-flowered, bisexual; *corolla* two valves.

PASPALUS. Finest-flower grass. Generic character: *calyx* two-valved, one-flowered; *corolla* two-valved, valves roundish, cartilaginous, convex on the outside, and rather inflex at the base; *stigmas* pencil-form; *seed*, husks permanently closed on the seed, which is compressed, and convex on one side.

- membranaceus*, *per.* membranaceous, nat. Carolina?
ceresia elegans, *per.* Ap.
stellatus, *per.* starry, nat. S. Amer.

- PASPALUS** *carinatus*, *per.* keeled, nat. S. Amer.
distichophyllus, *per.* fan-leaved, nat. S. Amer.
Humboldtianus, *per.* Humboldt's finest flower-grass, nat. S. Amer.
blepharophorus, *per.* ciliated, nat. S. Amer.
fasciculatus, *per.* bundled, nat. S. Amer. *var.*
hirtus, *per.* hairy, nat. S. Amer.
Bonplandianus, *per.* Bonpland's, nat. S. America.
candidus, *per.* pure white, nat. S. America.
pallidus, *per.* pale, nat. S. Amer.
dissectus, *ann.* dissected spiked, nat. America.
repens, *per.* creeping culmed, nat. S. Amer.
stolonifer, *per.* stoloniferous, nat. S. Amer.
lævis, *per.* smooth-leaved, nat. N. America.
scrobiculatus, *per.* dimpled-husked, nat. E. Indies.
polystachyus, *per.* numerous-spiked, nat. N. Holl.
Swartzianus, *per.* Swartz's, nat. E. Indies.
parviflorus, *ann.* small-flowered, nat. Porto Rico.
pusillus, *per.* branching-rooted, nat. Island, St. Thomas, Porto Rico.
conjugatus, *per.* double-spiked, nat. S. Amer.
notatus, *per.* notable, nat. St. Thomas, Carolina.
vaginatus, *per.* sheathed, nat. S. Amer.
furcatus, *per.* many-jointed, nat. Carolina.
platycaulis, *per.* one-jointed, nat. S. Amer.
capillaris, *per.* hair-like, nat. America.
mollis, *per.* soft, nat. America.
pulchellus, *per.* fair, nat. South America.
leptostachyus, *ann.* hard-branched, nat. S. Amer.
scoparius, *ann.* broom-like, nat. S. Amer.
villosus, *ann.* villose, nat. Japan.
annulatus, *per.* annular or ringed.
debilis, *per.* weak-culmed, nat. Cale.
filiformis, *ann.* thread-like.
serotinus, *per.* early, nat. Carolina.
Thouarsianus, *per.* naked, axilled, nat. Madagascar..
longiflorus, *per.* long-flowered, nat. Madagascar.
setaceus, *per.* bristly, nat. Carolina.
infirmus, *per.* slender-culmed, nat. Carolina.

PASPALUS pilosus, *per.* pilose, nat. America.

hirsutus, *per.* hairy, nat. China : allied to *P. setacea*.

cespitosus, *per.* turfy, nat. E. Indies.

glaber, *per.* smooth-leaved, nat. Porto Rico.

Forsterianus, *per.* Forster's, nat. New Caledonia.

undulatus, *per.* waved, nat. S. Amer.

Boscianus, *per.* fine-nerved, nat. Carolina.

lentiſer, *per.* nat. Carolina.

paniculatus, *per.* paniced, nat. Jamaica.

strictus, *per.* straight, nat. St. Domingo.

tenellus, *per.* small, nat. Germ.

virgatus, *per.* rod-like, nat. Caribbee.

Cochinchinensis, nat. Cochin China,

pubescens, *per.* Lagasca.

SYNTHESISMA. Syntherisma. Generic character: *calyx* one-flowered, three-valved, pressed close to the corolla, unequal, third valve smallest; *corolla*, exterior valve convex, interior flattish, embracing the other; *seed* covered by the husks of the corolla as with a crust.

ciliare, *ann.* hairy syntherisma, nat. Ger. July.

vulgare, *ann.* common, indig. August.

glabrum, *ann.* smooth. nat. Germ. August.

Malabaricum, *ann.* Malabar, nat. India, in sandy plains.

præcox, *ann.* early, nat. Florida.

villosum, *ann.* villous, nat. Jamaica.

serotinum, *ann.* late, nat. Carolina, in moist places.

CYNODON. Doob-grass. Generic character: *calyx* of two lanceolate, acute, spreading, equal valves, shorter than the *corolla* of two compressed very unequal valves; *floret* solitary; *seed* coated with the hardened corolla.
dactylon, *per.* creeping Doob-grass, nat. Britain and the East Indies.

maritimus, *per.* sea Doob-grass, nat. S. Amer.

radiatus, *per.* rayed Doob-grass, nat. E. Indies.

linearis, *per.* See *Cynodon dactylon*. "*Nil esse quam famosissimam Indorum Durvam.*"

stellatus, *per.* starry, nat. Island St. Helena.

virgatus, *per.* alternate-spiked, nat. India.

CYNODON *pilosus*, *per.* hairy, nat. India.

tenellus, *per.* small Doob-grass, nat. N. Holl.

polystachys, *per.* branched Doob-grass.

CRYPISIS. Crypsis. Generic character: *calyx* two-valved, one-flowered, compressed, unequal; *corolla* two-valved, interior longer than the calyx, exterior valve shorter than the calyx; *seed* covered by the corolla, somewhat columnar.

alopecuroides, *ann.* foxtail-like crypsis, nat. Germ.

geniculata, *ann.* jointed, nat. Mount Olympus.

aculeata, *ann.* diandrus, nat. shores of the Mediterranean.

schoenoides, *ann.* rush-like, nat. Germ. July.

phleoides, *per.* dense-spiked, nat. South Amer.

stricta, *per.* upright, nat. S. Amer.

macroura, *per.* long-panicled, nat. S. Amer.

aculeata, *ann.* prickly crypsis, nat. Germ.

PHALARIS. Canary-grass. Generic character: *calyx* two-valved and double, one-flowered, valves nearly equal, larger than the corolla; *corolla* two valves, enclosed in the calyx; *seed* ovate-oblong, covered by the corolla like a crust.

canariensis, *ann.* canary-grass, indig. August.

aquatica, *ann.* water canary-grass, nat. Germ.

arundinacea, *per.* sea-mat weed, indig.

intermedia, *per.* middle, nat. Amer.

Capensis, *per.* Cape, nat. Africa, in the European gardens at the Cape.

aristata, *per.* awned, nat. Spain.

paradoxa, *ann.* black bristled-spiked, nat. Germ. May, June.

cærulescens, *ann.* blue, nat. N. Africa.

arenaria, *ann.* sea canary-grass, indig. June, July.

tuberosa, *per.* tuberous, nat. Portugal.

semineutra, *per.* half-neutral, nat. Hungary.

bulbosa, *per.* bulbous-rooted, nat. Barbary.

pectinata, *ann.* comb-shaped, nat. Spain.

nodosa, *per.* knobbed-rooted, nat. South of Europe.

hispida, *per.* rough, nat. Japan.

dentata, *per.* tooth-keeled, nat. Cape of Good Hope.

PHALARIS *quadrivalvis*, per. four-valved, nat. Spain.

paniculata, per. panicle canary-grass, indig. July.

phleoides, per. indig. cat's-tail canary grass, July.

cristata, per. crested, nat. Arabia.

setacea, per. stiff-haired, nat. Arabia.

Caroliniana, per. cylindrical, nat. Amer.

utriculata, ann. Linn. See *Alopecurus utriculatus*.

PHLEUM. Cat's-tail grass. Generic character: *calyx* two-valved, sitting, strap-shaped, lopped, ending in two dagger-points, enclosing the blossom; *corolla*, two-valved, awnless, simple; *seed* loosely covered with the husks of the corolla.

pratense, per. meadow cat's-tail grass, indig. June, July.

var. *minus*, per. lesser meadow cat's-tail, indig. July, August.

nodosum, per. jointed, or bulbous-stalked, indig. August.

alpinum, per. Alpine cat's-tail grass, indig. June.

felinum, ann. oval cat's-tail grass, nat. Greece.

asperum, per. Flo. Ger.

supinum, ann.

Boehmeri, per. canary-like cat's-tail grass, indig. June, July.

Michelii, per. smooth, indig. June.

Hostii, per. *chilochloa* *Boehmeri*.

Gerardi, per. Gerard's cat's-tail-grass, nat. Germ. June.

tenue, ann. slender, nat. Ger. May.

crinitum, ann. bearded, indig. July.

MILIUM. Millet-grass. Generic character: *calyx* two-valved, one-flowered, valves nearly equal, ventricose; *corolla* two-valved, enclosed in the calyx, larger valve awned; *seed* covered with the corolla.

nigricans, per. blackish millet, nat. Guinea.

paradoxum, per. black-seeded millet, nat. Germ. July.

vernale, ann. spring, nat. Taurica, and sub-alpine situations.

effusum, per. common wood-millet, indig.

lendigerum, ann. yellow millet, indig. May and June.

Capense, per. Cape millet, nat. Cape of Good Hope.

capillare, per. hair-like, nat. E. Indies.

MILIUM *punctatum*, per. dotted millet, nat. Jamaica.

amphicarpon, per. simple-panicled, nat. New Jersey.

confertum, per. clustered, nat. Germ. June.

Gallecicum, per. many-stalked.

globosum, per. globular, nat. Japan. June.

velutinum, ann. nat. Cape of Good Hope.

microspermum, ann. small-seeded, nat. New Spain.

tomentosum, per. woolly, nat. East Indies.

POLYPOGON. Beard-grass. Generic character: *calyx* of two valves, awned at the summit, concealing the *corolla* of two valves, outermost with a terminal awn; *seed* loose.

monspeliensis, annual beard-grass, indig. July, August.

littoralis, perennial beard-grass, indig. June.

AGROSTIS. Bent-grass. Generic character: *calyx* one-flowered, two-valved, spear-shaped, acute, generally rough on the keel, longer than the blossom; *corolla* two-valved, summits of the styles hairy; *seed* loosely covered by the *corolla* husks.

spica-venti, ann. silky bent-grass, indig. June and August.

palustris, per. marsh bent-grass, indig. July, August.

canina, per. brown bent, indig. July.

Coromandeliana, per. Coromandel bent, nat. Arabia.

plumosa, ann. feathery bent, nat. Calabria.

composita, ann. compound-panicled bent, nat. Amer.

nutans, per. nodding bent, nat. Amer.

vinealis, per. slender trailing bent, indig. July, September.

procera, per. tall bent, nat. Malabar.

arachnoidea, per. spider-branched bent.

Magellanica, per. hairy-calyced bent, nat. Straits of Magellan.

pallida, per. pale bent, indig. May and June.

articulata, per. jointed bent, nat. Portugal.

panicoides, per. short-calyced bent, nat. (?)

Alpina, per. Alpine bent, Wither. Arr.; indig.

versicolor, per. various-coloured bent.

littoralis, per. sea-side bent.

capillaris, ann. capillary bent, nat. Germ.

interrupta, per. interrupted spiked bent, nat. Germ.

AGROSTIS neglecta, per. neglected bent.

pauciflora, per. small-flowered, nat. Germ.

miliacea, per. millet bent, nat. Spain. July.

parvula, per. smaller bent, nat. Hungary

setacea, per. bristly bent, indig. July.

tenuifolia, per. slender-leaved bent, nat. Germ.

repens, per. creeping-rooted, indig. August.

involuta, per. involute-leaved bent, nat. (?)

alba, per. white bent, indig.

patula, per. spreading bent, nat. Switzerland.

stolonifera, per. stoloniferous bent, indig. July.

var. *aristata*, per. awned stoloniferous bent, indig.

var. *angustifolia*, per. smaller-leaved stoloniferous bent.

var. *latifolia* vel *Richardsonia*, florin.

fascicularis, per. tufted-leaved bent, indig. June, July.

spuria, per. spurious bent, nat. Hungary.

tenella, per. weak bent, nat. Germ.

vulgaris, per. common bent, indig. June, July.

lobata, per. lobed-panicled bent, indig. July.

oliganthe, per. slender-branched bent, nat. Amer.

Mexicana, per. Mexican bent grass, nat. Mexico.

var. *ramosissima*, branching Mexican bent.

cinna, per. rooting bent, nat. Amer.

sciurea, per. acuminate bent, nat. N. Holl.

rara, per. scarce bent, nat. Port Jackson.

cylindrica, per. cylindrical bent, nat. N. Holl.

monticola, per. triandrous bent, nat. Van Diemen's Land.

Forsteri, per. slenderest panicled bent.

Labillardieri, per. Labillardiere's bent, nat. N. Zeal.

æmula, per. toothed bent, nat. N. Holl.

rudis, per. rough bent.

plebeja, per. double-awned bent.

decipiens, per. loose-panicled bent.

humifusus, per. moist-growing bent, nat. S. Amer.

atrovirens, ann. dark green bent, nat. S. Amer.

trichodes, ann. knee-jointed bent, nat. S. Amer.

elegans, per. elegant bent, nat. S. Amer.

fasciculata, per. bundled, nat. S. Amer.

ramosa, per. double-stalked bent, nat. Germ.

AGROSTIS sobolifera, *per.* contracted panicled bent, nat. America.

hirsuta, *per.* hairy bent, nat. Teneriffe.

debilis, *per.* weak bent.

retrofracta, *ann.* reflexed-branched bent.

Tolucensis, *per.* Toluca bent, nat. S. America.

virescens, *per.* greenish bent, nat. S. America.

pubescens, *per.* downy bent, nat. S. America.

lanata, *per.* woolly bent, nat. S. America.

diandra, *per.* diandrous bent, nat. East Indies.

pulchella, *per.* fair bent, nat. New Holland.

Indica, *ann.* Indian bent, nat. New Holland.

purpurescens, *ann.* purplish bent, nat. Jamaica.

elongata, *ann.* elongated bent, nat. New Holland.

tenacissima, *per.* tough bent, nat. Caribbees.

clandestina, *per.* narrow panicled bent, nat. America.

purpurea, *per.* purple bent, nat. Germany.

procumbens, *per.* procumbent bent, nat. Hungary.

crinita, *per.* long-awned bent, nat. New Zealand.

pyramidata, *per.* pyramidal bent, nat. S. America.

tenuiflora, *per.* slender-flowered bent, nat. America.

monandra, *ann.* monandrous bent, nat. America.

Michauxii, *ann.* Michaux's bent, nat. America.

ciliata, *ann.* ciliated bent, nat. Japan.

juressi, *ann.* flat-leaved bent, nat. Spain.

gracilis, *ann.* meagre-panicled bent, nat. Germany.

frondosa, *per.* nat. Italy. Allied to *A. alba*.

dubia, *per.* dubious bent, nat. Germany.

gigantea, *per.* giant bent, nat. Germany.

Valentina, *per.* Valentia bent.

Kitaibelii, *per.* nat. Germany.

spicata, *per.* spiked bent, nat. Arabia.

pungens, *per.* pointed-leaved bent, nat. Spain.

tremula, *ann.* tremulous bent, nat. America.

parviflora, *ann.* small-flowered, nat. New Holland.

Virginica, *per.* Virginian bent, nat. America.

distichophylla, *per.* fan-leaved bent, nat. Botany Bay.

Capensis, *per.* Cape bent.

aspera, *per.* rough bent, nat. America.

AGROSTIS lateriflora, *per.* lateral-flowered bent, nat. Am.

racemosa, *per.* branching bent, nat. America.

dispar, *per.* many-flowered bent, nat. America.

ARUNDO. Reed grass. Generic character: *calyx* one-flowered, seldom many-flowered, two-valved; *flowers* erect; *corolla* two-valved, acuminate, surrounded at the base with downy hairs; *seed* loosely enclosed by the corolla husks.

epigejos, *per.* wood reed grass, indig. July.

littorea, *per.* sea side, nat. Germany. July.

purpurascens, *per.* purplish.

pseudophragmites, *per.* false reed, nat. Germany. July.

intermedia, *per.* middle reed, nat. Germany.

laxa, *per.* loose-panicled reed, nat. Germ.

annulata, *per.* ringed-pedicelled reed, nat. Germany.

glauca, *per.* glaucous reed, nat. Germany.

strigosa, *per.* thin reed, nat. Germany.

Lapponica, *per.* Lapland reed, nat. Lapland.

confinis, *per.* adjoining reed, nat. America.

montana, *per.* mountain reed, nat. Germany.

agrostoides, *per.* bent-like reed, nat. America.

Canadensis, *per.* Canadian reed, nat. Canada.

Quitensis, *per.* weak-panicled reed, nat. Mexico.

tenuifolia, *per.* small-leaved reed, nat. in cultivated places near the city of Mexico.

bifaria, *per.* double-leaved reed, nat. East Indies.

Australis, *per.* Southern reed.

Egmontiana, *per.* leafy reed.

pygmæa, *per.* dwarf reed.

nitida, *per.* shining reed.

calamagrostis, *per.* bent-like reed, indig.

stricta, *per.* upright reed, indig. June to August.

varia, *per.* various-panicled reed, nat. Germany.

acutiflora, *per.* acute-flowered, nat. Germany. June.

sylvatica, *per.* Calmuc reed, nat. Germany. June, July.

speciosa, *per.* elegant reed, nat. Germany. July, August.

tenella, *per.* small reed, nat. Germany. July.

arenaria, *per.* sand reed, indig. July and August.

Baltica, *per.* Baltic sea-reed, nat. Germany. July.

The following species of Arundo contain more than one flower in each calyx, and are an exception to this arrangement.

ARUNDO phragmites, *per.* common, indig. August.

donax, *per.* cultivated, nat. South of Europe.

conspicua, *per.* showy, nat. New Zealand.

SACCHARUM. Sugar grass. Generic character: *calyx* two-valved, one-flowered, furnished or clothed with long silky hairs; *corolla* two valves; *seed* invested by the husks of the corolla.

cylindricum, *per.* cylindric sugar grass, nat. Germany.

fulvum, *per.* nat. New Holland.

Mexicanum, *ann.* nat. Mexico.

Ravennæ, *per.* Italian, nat. Italy. July and August.

Teneriffæ, *per.* Teneriffe, nat. Sicily.

officinarum, *per.* sugar cane, nat. Indies.

var. violaceum, *per.* violet, nat. Indies.

contractum, *per.* nat. Domingo.

Egyptiacum, *per.* nat. Egypt.

arundinaceum, *per.* nat. Tranquebar.

polystachyum, *per.* nat. St. Christopher's.

LAGURUS. Hare's tail grass. Generic character: *calyx* two valves, one-flowered, each valve ending in a villose awn; *corolla* two valves, the exterior valve having three awns; the middle awn, from the back of the valve, bent and twisted; *seed* covered, awned.

ovatus, *ann.* oval-spiked hare's tail grass, indig. July.

STIPA. Feather grass. Generic character: *calyx* two-valved, one-flowered; *corolla* two valves, the exterior valve furnished with a long awn, which is jointed at the base; *seed* oblong, covered.

humilis, *per.* dwarf, nat. S. America.

tortilis, *ann.* twisted, nat. Barbary and Greece.

gigantea, *per.* tall, nat. S. America.

Lagasæ, *per.* bristly-leaved, nat. —?

Capensis, *per.* Cape, nat. Cape of Good Hope.

Virginica, *per.* Virginian, nat. America.

avenacea, *per.* oat-like, nat. America.

parviflora, *per.* small-flowered, nat. Macassar.

flavescens, *per.* yellow, nat. Van Diemen's Land.

STIPA pennata, per. soft feather-grass, indig. June.

barbata, per. bearded, nat. Mascar.

capillata, per. capillary, nat. Germ. June.

mollis, per. nat. Port Jackson.

spicata, per. spiked, nat. C. Good Hope.

junceae, per. rush-leaved, nat. France. July.

bicolor, per. two-coloured, nat. Brazil.

aristella, per. short-awned, nat. France. July.

ibarrensis, per. nat. South America.

tenacissima, per. tough, nat. Spain. August.

fimbriata, per. nat. South America.

eminens, per. nat. South America.

mucronata, per. nat. South America.

virescens, per. nat. South America.

eristachya, per. nat. South America.

Sibirica, per. nat. Siberia.

Canadensis, per. (allied to *Stipa Sibirica*), nat. Amer.

membranacea, per. membraneous, nat. Portugal.

hymenoides, per. nat. America.

elegantissima, per. most elegant, nat. Van Diemen.

pubescens, per. downy, nat. Port Jackson.

micrantha, smooth-seeded, nat. N. Holl.

setacea, per. bristly, nat. N. Holl.

compressa, per. flat-stalked, nat. N. Holl.

Ucranica, per. tufty-leaved.

stricta, per. upright, nat. Carolina.

panicoides, per. panic-like, nat. S. Amer.

LAPPAGO. lappago. Generic character: *calyx* three-valved; *corolla* two-valved, valves inverse or resupine; *seed* covered loosely by the corolla.

racemosa, branching lappago, nat. South of Europe. August.

ROTTBOELLIA. Hard-grass. Generic character: *spike-stalk*, or *rachis*, jointed, roundish, excavated—in which the florets are wholly or partly immersed; *calyx* one or two-valved, lateral, containing one or two flowers; *flowers* alternate, on a zig-zag foot-stalk: *seed* covered by the blossom.

incurvata, ann. sea hard-grass, indig. Flowers in June.

ROTTBOELLIA *filiformis*, *per.* slender, nat. S. Eur. July.

monandra, *ann.* single hard-grass, nat. Germ.

digitata, *per.* fingered, nat. Greece.

cylindrica, *per.* four-rowed, nat. S. of Europe.

lævis, *per.* smooth-calyced, nat. Tranquebar.

compressa, compressed-spiked, nat. Sierra Leone.

stolonifera, *per.* creeping, nat. —?

fasciculata, *per.* bundled, nat. Africa.

muricata, *ann.* prickly, nat. India.

LEERSIA. Leer's-grass. Generic character : *calyx* wanting ; *corolla* two-valved, inferior compressed, keeled, superior narrower, lanceolate ; *stamina* one, three, six ; *seed* oval, compressed, furrowed.

oryzoides, *per.* rice-like, nat. Germ.

Virginica, *per.* Virginian, nat. Amer.

monandra, *per.* single, nat. Jamaica.

hexandra, *per.* six-stamened, nat. Jamaica.

Australis, *per.* Southern, nat. New Holland.

Mexicana, *per.* Mexican, nat. S. Amer.

lenticularis, *per.* ciliate-husked, nat. Amer.

ovata, *per.* oval, nat. Amer.

imbricata, *per.* imbricated, nat. Carolina.

digitata, *per.* fingered, nat. Amer.

(*Melica ciliata et uniflora excipiuntur.*)

SECT. VI. Grasses with three stamina, two styles ; one flower in every calyx—Flowers of different sexes.

ANDROPOGON. Andropogon. Generic character : *calyx* two-valved, one-flowered, outer valve embracing the inner, cartilaginous ; *corolla* two-valved, awned, male flowers on foot-stalks single, or in pairs to each female flower ; *seed* oblong, covered with the blossom.

divaricatus, *per.* divaricate, nat. Amer.

nutans, *per.* nodding, nat. Virginia.

avenaceus, *per.* oat-like, nat. of Illinois.

strictus, *per.* upright, nat. vineyards of France.

flexilis, *per.* pliant, nat. North America.

macrouris, *per.* nat. Carolina and Florida.

ANDROPOGON *dissitiflorus*, per. distant-flowered, nat. Am.
ternarius, per. remote-branched, nat. Amer.
hirtus, per. hairy, nat. S. of Europe.
furcatus, per. forked, nat. N. America.
tenuis, per. slender, nat. N. Holland.
triticeus, per. wheat-like, nat. N. Holland.
sericeus, per. silky, nat. N. Holland.
affinis, per. nat. N. Holland.
intermedius, per. nat. N. Holland.
procerus, per. tall, nat. N. Holland.
exaltatus, per. nat. N. Holland.
lanatus, per. woolly, nat. N. Holland.
bombycinus, per. nat. N. Holland.
refractus, per. nat. N. Holland.
fragilis, per. brittle, nat. N. Holland.
citreus, per. nat. N. Holland.
dystachyum, per. two-rowed andropogon, nat. Germ.
ischæmum, per. woolly-spiked, nat. Germ.
gryllus, per. purple-spiked, nat. Germ.
arundinaceum, per. reed-like, nat. Germ.
schœnanthus, per. sweet lemon-grass, nat. East Indies.

HORDEUM. Barley-grass. Generic character: *calyx* lateral, six-valved (the valves, collectively, constitute what is called a six-leaved involucre); *corolla* two-valved, exterior valve furnished with a long awn; flowers in threes, the middle flower fertile or bisexual, and the lateral ones barren, or furnished with stamens only; *seed* covered closely with the corolla, which remains permanent.

nigrum, per. black, var. common barley.

strictum, per. upright (allied to *H. bulbosum*), nat. in Italy.

Capense, ann. Cape, nat. Cape of Good Hope.

ascendens, ann. ascending, nat. Mexico.

Chilense, ann. Chilian, nat. Chili.

vulgare, ann. spring barley, supposed to be a native of Sicily.

hexastichon, ann. bear, or big.

distichon, ann. common or winter barley.

HORDEUM *murinum*, ann. wall-barley, or way-bennet, indig.
maritimum, ann. sea barley-grass, indig. May.
jubatum, ann. long-bearded, nat. North America.
zeocriton, ann. sprat, or battledore barley. August.
bulbosum, per. bulbous-rooted barley.
pratense, per. meadow barley, indig. June.

SECT. VII. *Grasses with three stamina, two styles, two flowers
 in each calyx — Flowers bisexual.*

AIRA. Hair-grass. Generic character: *calyx* two-valved,
 two-flowered, without any rudiment of a third floret;
corolla two-valved, outer valve awned, the awn rising
 from the back a little above the base — seldom awnless;
seed loosely covered.

aquatica, per. water hair-grass, indig. June, July.
cristata, per. crested hair-grass, indig. June.
arundinacea, per. reed-like hair-grass, nat. Levant.
cæspitosa, per. turfy hair-grass, hassock-grass, indig.
ambigua, per. doubtful.
flexuosa, per. zig-zag mountain hair-grass, indig. June.
pulchella, ann. fair, nat. Spain.
caryophyllea, ann. silver, indig. May.
elegans, ann. elegant, nat. Germ.
præcox, ann. early, indig. April.
tenera, ann. tender.
setacea, per. bristly, nat. Europe.
canescens, per. grey, indig. June.
capillacea, per. slender, nat. Amer.
subspicata, per. spiked hair-grass, nat. Germ. June.
articulata, ann. jointed, nat. Spain.
Antartica, per. South-Sea hair-grass, nat. New Zealand.
alba, per. white hair-grass, nat. Greenland.
involutrata, per. involucred, nat. Spain.
media, per. middle hair-grass, nat. France.
atropurpurea, per. dark purple, early in September.
triflora, per. three-flowered, nat. Spain.
lendigra, ann. compound-panicled, nat. Spain.
Chinensis, ann. Chinese, nat. China.
duriuscula, ann. hardish, nat. —?

AIRA oryzetozum, ann. nat. rice-grounds, Verona.

pallens, ann. pale, nat. Pennsylvania.

macrantha, ann. short-leaved.

humilis, per. dwarf, nat. Mount Caucasus.

pallescent, per. palish.

nitida, per. shining.

discolor, per. discoloured.

alpina, per. alpine, indigenous.

junceae, per. rush-like, nat. Cape G. Hope.

refracta, per. refracted-leaved, nat. Germ.

involucrata, per. involucreated, nat. Spain.

globosa, per. globose-husked, nat. France.

obtusata, per. obtuse-husked, nat. Carolina.

brevifolia, per. short-leaved, nat. Amer.

minuta, ann. minute, nat. Spain.

agrostidea, per. bent-like, nat. France.

MELICA. Melic-grass. Generic character: *calyx* two-valved, two-flowered, with the rudiment of one or two florets, that are abortive and placed between the others: *corolla* two-valved, awnless; *seed* ovate, grooved.

ciliata, per. ciliated, nat. Ger. May and June.

nutans, per. nodding, indig. May.

major, per. larger, nat. Greece.

saxatilis, per. rock, nat. Greece.

uniflora, per. one-flowered, indig. May and June.

cærulea, per. purple indig. July and August.

Bauhini, per. nat. Europe, Barbary.

pyramidalis, per. pyramidal, nat. Italy.

laxiflora, per. loose-flowered.

speciosa, per. handsome, nat. Virginia.

papilionacea, per. butterfly, nat. Brazil.

aurantiaca, per. golden, nat. Montevideo.

violacea, per. violet, nat. Montevideo.

rigida, per. rigid, nat. Montevideo.

decumbens, per. decumbent, nat. Cape of Good Hope.

racemosa, per. simple-culmed, nat. Cape of Good Hope.

hirsuta, per. hairy, nat. Germ.

diffusa, per. branching-panicled, nat. Virginia.

scabra, per. rough, nat. S. Amer., frigid regions.

MELICA *pallida*, per. pale, nat. S. Amer.

capillaris, per. hair-like, nat. S. Amer.

festucoides, per. fescue-like, nat. C. G. H.

minuta, per. small, nat. Italy. June.

altissima, per. tall, nat. Siberia.

SECALE. Rye. *Calyx* two-valved, two-flowered, solitary ;
corolla two-valved, two-flowered, exterior valve acuminate, keel ciliated, ending in a long awn ; interior valve flat, lanceolate ; *seed* naked, half cylindrical, pointed at one end.

cereale, ann. rye. Supposed a native of Crete or Siberia.

villosum, ann. hairy, nat. South of Europe and Levant.

orientale, ann. oriental, nat. of the Archipelago.

Creticum, ann. Cretan, nat. of Candia, or Crete.

SECT. VIII. *Grasses with three stamina, two styles, two flowers in each calyx—Flowers of different sexes.*

HIEROCHLOE. Holy-grass*. Generic character ; *florets* three, central one perfect, with two stamens, lateral ones barren with three ; *corolla* permanently membranous ; *seed* loose ; *styles* distinct.

fragrans, per. fragrant holy-grass, nat. N. Amer.

borealis, per. Northern holy-grass, indig. April and May.

alpinus, per. alpine holy-grass, nat. Greenland.

redolens, per. redolent or balmy holy-grass, nat. New Zealand.

Australis, per. Southern holy-grass.

HOLCUS. Soft-grass. Generic character : *calyx* two-valved, two-flowered, seldom three, awnless, *corolla* two-valved, exterior valve awned, interior valve awnless, least, unisexual or barren flowers, on foot-stalks—they also want the inner husks ; *seed* ovate, awned.

avenaceus, per. tall oat-like soft-grass, indig. June till October.

* *Hierochloe borealis* is said to be used at high festivals, for strewing the churches in Prussia ; as *Acorus calamus*, has, time out mind, been employed in the cathedral and streets of Norwich, on the Mayor's day.—*Sm. Engl. Fl.* vol. i, p. 111.

HOLCUS, var. *bulbosus*, per. bulbous-rooted, indig. June till October.

var. *muticus*, per. awnless, tall oat-like soft grass.

mollis, per. downy, or creeping-rooted, indig. July.

lanatus, per. woolly, indig. June.

striatus, per. striated, nat. Virginia.

spicatus, ann. spiked, nat. East Indies.

Sorghum, ann. cultivated, or Indian millet.

fragrans, per. fragrant.

argenteus, per. silvery, nat. Spain.

striatus, per. striated, nat. Virginia.

Dochna, per. spreading, nat. Arabia.

racemosus, per. cylindrical.

nigerrimus, ann. black, Tef. Bruce.

bicolor, ann. two-coloured, nat. Persia.

cernuus, ann. drooping, nat. Germ.

saccharatum, ann. nat. East Indies.

Caffrorum, ann. Caffres' bread.

decolorans, ann. nat. S. Amer.

hirsutus, ann. hairy-seeded, nat. C. G. H.

serratus, ann. saw-leaved, nat. C. G. H.

asperus, ann. rough-leaved, nat. C. G. H.

halepensis, per. loose-panicled, nat. Germ.

nilidus, per. shining, nat. E. Indies.

setifolius, per. bristly-leaved, nat. C. G. H.

parviflorus, per. small-flowered, nat. C. G. H.

fulvus, per. tawny-coloured, nat. N. Holl.

plumosum, per. feather-like, nat. N. Holl.

elongatum, per. elongated, nat. New Holland.

PANICUM. Panic-grass. Generic character; *calyx* two-valved, imperfectly two-flowered—one fertile, or bisexual, and the other barren, or neuter; *corolla* one-two-valved, awnless, or awned at the apex, coriaceous, dotted, or furrowed when enclosing the ripe seed, neuter floret of one or two valves; *seed* covered like a crust.

colonum, ann. husbandman's, nat. N. Spain, cultivated in India.

pseudo-colonum, ann. spurious, E. Indies.

- PANICUM obtusum**, *per.* obtuse, nat. S. America.
fluitans, *per.* flote, nat. India.
mucronatum, *per.* mucronate, E. Indies.
brizoides, *bien.* briza-like, nat. India.
cruciforme, *per.* cross-spiked, nat. Isle Samos.
granulare, *per.* nat. Isle of France.
flavidum, *per.* flame-coloured, nat. Ceylon.
dimidiatum, *per.* half one-rowed, nat. India.
pilosum, *per.* tufted-haired, nat. mountainous pastures in India.
molle, *per.* soft, nat. Surinam.
fasciculatum, *per.* bundled, nat. S. America.
barbatum, *per.* bearded, nat. Isle France.
pyramidale, *per.* pyramidal, nat. Bengal.
plicatum, *per.* nat. E. Indies.
Carthaginense, *per.* nat. S. America.
conglomeratum, *per.* nat. E. Indies.
decumbens, *per.* decumbent, nat. Jamaica.
cespitosum, *per.* turfy, nat. Jamaica.
hispidulum, *per.* hispid, nat. E. Indies.
dichotomum, *per.* nat. Carolina.
micranthum, *per.* nat. S. America.
proliferum, *per.* proliferous, nat. Virginia.
deustum, *per.* nat. Cape of Good Hope.
coloratum, *per.* coloured-stamened, nat. Antilles.
repens, *per.* creeping, nat. Africa and Italy.
obliquum, *per.* oblique, nat. E. Indies.
verticillatum, *ann.* whorle-flowered, indig. July.
sericeum, *ann.* silky, nat. E. Indies.
purpurascens, *ann.* purplish, nat. S. America.
viride, *ann.* green, indig. July and August.
Germanicum, *ann.* German, nat. S. Europe.
glaucum, *ann.* glaucous, nat. Germ.
gracilis, *ann.* graceful, nat. S. America.
hirtellum, *ann.* small, hairy. July and August.
maritimum, *ann.* sea, cult. Paris gardens.
miliaceum, *ann.* millet, nat. Germ., India.
crus galli, *ann.* cock's-foot panic, indig. July and Aug.
crus corvi, *ann.* crow's-foot panic, nat. East Indies, hardy.

- Panicum arborescens*, per. tree panic-grass. March, April.
latifolium, per. broad-leaved, nat. North America.
difforme, per. nat. E. Indies.
Numidianum, per. nat. Calle, in moist sands.
ischæmoides, per. nat. in Malabar.
remotum, per. distant-branched, nat. Tranquebar.
Sumatrense, per. nat. Sumatra.
attenuatum, per. nat. India.
miliare, per. nat. E. Indies.
notatum, per. nat. Sumatra.
muricatum, per. nat. E. Indies.
capillare, ann. capillary, nat. Virginia.
commelinefolium, ann. commelina-leaved.
tenellum, ann. small, nat. Sierra Leone.
flexuosum, ann. zig-zag, nat. India.
grossarium, ann. nutritious, nat. ——— ?
maximum, per. large, or Guinea-grass.
bulbosum, per. bulbous, nat. S. America.
hirsutum, per. hairy, allied to the Guinea-grass, nat. Jamaica.
nemosum, per. wood, nat. wood mountains, Jamaica.
rigens, per. knee-jointed, nat. S. America.
fuscum, per. brown, nat. Jamaica.
zizanioides, per. nat. S. America.
flavescens, per. yellow, nat. Jamaica.
diffusum, per. diffuse, nat. E. Indies.
oryzoides, per. rice-like, nat. Jamaica.
clandestinum, per. obscure-flowered, nat. America.
curvatum, per. curved-calyced, nat. E. Indies.
uliginosum, per. March, nat. E. Indies.
virgatum, per. twiggy, nat. America.
avenaceum, per. oat-like, nat. South America.
trigonum, per. three-seeded, nat. India.
pallens, per. pale-green flowered, nat. Jamaica.
anceps, per. simple-panicked, nat. moist woods, America.
scoparium, per. broom, nat. Amer. allied to *P. latifolium*.
Rudgei, per. Rudge's, nat. S. America.
polygonoides, per. buck-wheat-like, nat. Cayenne.
parvifolium, per. small-leaved, nat. S. America.

PANICUM *granuliferum*, *per.* granulous, nat. New Guinea.
pubescens, *per.* pubescent, nat. Lower Carolina.

Xalapense, *per.* pilose-leaved, nat. temperate regions of Mexico.

nitidum, *ann.* shining, nat. Carolina.

barbulatum, *ann.* bearded-jointed, nat. Carolina.

discolor, *ann.* discoloured, nat. Pennsylvania.

ramulosum, *ann.* branching, nat. Carolina.

striatum, *ann.* striated, nat. N. America.

melicarium, *ann.* weak-culmed, nat. America.

patentissimum, *ann.* spreading, nat. Carolina.

lanatum, *ann.* woolly, nat. Jamaica.

arundinaceum, *ann.* reed-like, nat. Jamaica.

radicans, *ann.* rooting, nat. China.

brevifolium, *ann.* short-leaved, nat. S. America.

ventricosum, *ann.* ventricose-husked, nat. India.

villosum, *ann.* villous, nat. India.

Hoffmannseggii, *ann.* nat. — ?

divaricatum, *per.* divaricate-culmed, nat. Jamaica.

neglectum, *per.* neglected, nat. Africa ?

ruscifolium, *per.* ruscus-leaved, nat. hot arid soils of Mexico.

elongatum, *per.* elongated, nat. Virginia.

interruptum, *per.* interrupted, nat. India.

phalarioides, *per.* canary-grass-like, nat. Java.

ramosum, *per.* branching, nat. India.

acuminatum, *per.* acuminate, nat. sandy soils, Jamaica.

laxum, *per.* loose, nat. dry woods, Jamaica.

glutinosum, *per.* glutinous, nat. S. America.

patens, *per.* spreading, nat. India — Portugal.

multinode, *per.* many-jointed, nat. Isle of France.

aristatum, *per.* awned, nat. China.

sabulorum, *per.* awl-shaped, nat. Montevideo.

nervosum, *per.* nerved-leaved, nat. Cayenne.

laxiflorum, *ann.* loose-flowered, nat. Virginia.

agrostoides, *ann.* agrostis-like, nat. — ?

myurus, *ann.* mouse-tail, nat. Guinea.

hirtum, *ann.* hairy-husked, nat. Cayenne.

amplexicaule, *ann.* stem-clasping, nat. Guinea.

PANICUM *Bobartii*, ann. Bobarts', nat. America.

altissimum, ann. tall, nat. unknown.

rectum, ann. upright, nat. Pennsylvania.

abludens, ann. unlike, nat. East Indies.

canescens, ann. grey, nat. East Indies.

Isachne, ann. tiled-branched, nat. East Indies.

pilosissimum, ann. pilose-leaved, nat. Essequibo.

Mertensii, ann. Mertens', nat. Essequibo.

scaberrimum, ann. very rough, nat. New Spain.

Heynii, ann. Heyn's, nat. East Indies.

* Species with solitary spikes and naked flowers.

rarum, ann. scarce, nat. New Holland.

phleoides, ann. cat's-tail-like, nat. New Holland.

mysosuroides, ann. creeping-culmed, nat. New Holland.

arcuatum, ann. arched, nat. New Holland.

** Spikes alternately undivided, half awnless.

strictum, ann. straight, nat. New Holland.

gracile, ann. slender, nat. New Holland.

argenteum, ann. silvery, nat. New Holland.

holosericeum, silky-flowered.

polyphyllum, ann. leafy-culmed.

*** Sub-panicked, spikelets divided, alternately awnless.

marginatum, ann. margined-leaved.

airoides, ann. hair-grass-like.

pubigerum, ann. pubescent-culmed.

foliosum, ann. leafy.

pauciflorum ann. few-flowered.

pygmæum, ann. dwarf.

minutum, ann. minute.

bicolor, ann. two-coloured.

uncinulatum, ann. hook-husked.

effusum, ann. scattered panicked.

decompositum, ann. decomposed panicked.

**** Spikes alternate or crowded, flowers alternate.

semiliatum, ann. half-winged.

***** Spikes bundled, sub-digitate, flowers awnless.

parviflorum, ann. small-flowered.

striatum, ann. striated.

radiatum, ann. rayed.

PANICUM *divaricatissimum*, ann.*Brownii*, ann. Brown's, nat. New Holland.

***** Spiked, spikes digitate, bundled, solitary; exterior valve of the husk very small, or none.

papposum, ann. woolly-flowered.*tenuiflorum*, ann. fine-flowered.*propinquum*, ann. allied.*gibbosum*, ann. gouty.

***** Exterior flowers masculine, inner feminine, smaller, spike-stalk apex naked, awn-like, aquatic, culms creeping.

paradoxum, ann. paradoxical.*spinescens*, ann. spiny.*New Species discovered by Humboldt and Bonpland.*

1. Spikes solitary, spikelets solitary, two-rowed.

rotthoelloides, per. hard grass-like, nat. S. America.

2. Spikes solitary, spikelets in twos, flowering on one side.

monostachyum, per. single, nat. S. America.

3. Spikes verticillate, bundled, or panicled, much digitated, or fingered.

ascendens, per. ascending, nat. S. America.

4. Panicled, spikelets conglomerate.

decolorans, per. various-coloured, nat. S. America.

5. Spikelets of the panicle spreading, or scattered.

divergens, per. diverging, nat. S. America.*olyroides*, per. amel-corn-like, nat. S. America.*aturense*, per. blackish, nat. S. America.*glaucescens*, per. glaucous, nat. S. America.SECT. IX. *Grasses with three stamina, two styles, several flowers in each calyx (except spartina), flowers all bisexual, the terminating floret frequently unisexual or barren.***LOLIUM.** Ray-grass, or darnel. Generic character: *calyx* of one valve, lateral, fixed, pressing a spikelet of flowers close to the rachis, or spike-stalk; *corolla* two-valved, spear-shaped, exterior valve near the apex, sometimes awned; *seed* covered with the corolla husks, convex on one side, and furrowed on the other.

LOLIUM *perenne* vulgare, *per.* ray-grass, perennial ray-grass, indig. June till August.

perenne tenue, *per.* slender ray-grass; the spike is erect, very slender, calyx containing two or three florets.

perenne Whitworthensis*, *per.* Whitworth's ray-grass; spike slender, leaves numerous, narrower, light green.

perenne stolonifera, *per.* stoloniferous; culm short, spike short, crowded, culms rooting at the base.

perenne compositum, *per.* doubled-spiked ray-grass; spike generally bent, spikelets broad, crowded.

perenne monstrosum, *per.* double-flowering ray-grass; spikelets round or globular.

perenne Stickniensis†, *per.* Stickney's ray-grass; spike long, spikelets numerous, leaves broad, long, pale green.

perenne ramosum, *per.* branched ray-grass; spike with branches towards the top; calyx eight or nine flowered.

paniculatum, *per.* paniced.

perenne Russellianum‡, *per.* Russell's ray-grass; spike long, spikelets pointed, leaves numerous, broad, long, dark green.

perenne viviparum, *per.* viviparous ray-grass; truly viviparous, never producing seeds, but plants.

multiflorum, *per.* many (twenty to twenty-five) flowered ray-grass, nat. France; in pastures, and on the margins of corn fields.

temulentum, *ann.* bearded annual ray-grass, indig. July.
The deleterious darnel.

arvense, *ann.* field annual ray-grass, indig. June and July.

majus, *ann.* larger field ray-grass.

complanatum, *ann.* dwarf annual ray-grass, nat. Switzerland. July or August, as early or late sown.

* First introduced and cultivated by G. Whitworth, Esq. of Acre House, Lincolnshire.

† The seed of this variety I received under the name of Stickney's ray-grass.

‡ First cultivated by Benjamin Holdich, Esq., from seed obtained of a plant in a rich fen pasture, pointed out to Mr. Holdich by the Duke of Bedford.

LOLIUM speciosum, *per.* specious ray-grass, nat. Iberia; spikelets as large as those of *festuca fluitans*.

maximum, *ann.* largest ray-grass, nat. Jamaica.

ÆGILOPS. Goat's face grass. Generic character: *calyx* opposite, two-valved, three or four-flowered, ventricose, hard, truncated, furnished with various awns; *germen* bearded on the apex; *corolla* two-valved, exterior valve ovate, terminated by a double or triple awn; *seed* oblong, convex on one side, and grooved on the other.

ovata, *ann.* oval-spiked goat's-face-grass, nat. Germany.

triaristata, *ann.* three-awned, nat. Germany.

triuncialis, *ann.* long-spiked, nat. Germany. June.

caudata, *ann.* slender-spiked, nat. Hungary.

cylindrica, *ann.* cylindrical, nat. Hungary, Italy; by roadsides, vineyards, and dry places.

comosa, *ann.* dense-spiked, nat. Isles of Greece.

ciliaris, *ann.* ciliated, nat. E. Indies.

hirsuta, *per.* hairy-spiked, nat. Egypt.

villosa, *per.* villous, nat. India.

SESLERIA. Moor-grass. Generic character: *involucre* many-leaved, leaflets sometimes deciduous; *calyx* two-valved, two or three-flowered, awned; *corolla* two-valved, awned, awns various; *stigma* long-feathered; *spike* compound; *seed* covered by the blossom.

elongata, *per.* long-spiked moor-grass, nat. Germany.

cylindrica, *per.* cylindrical-spiked, nat. Switzerland.

tenuifolia, *per.* small-leaved, nat. Germany. June.

cærulea, *per.* blue, indig. April and May.

albicans, *per.* whitish, nat. rocks.

phleoides, *per.* cat's-tail-like, nat. Eastern Alps.

nitida, *per.* shining, nat. —?

sphærocephala, *per.* globular, nat. Germany.

tenella, *per.* slender, nat. Germany. June.

alba, *per.* white, nat. Belgrade.

echinata, *ann.* rough, nat. Germany. June.

disticha, *per.* two-rowed, nat. Germany.

POA. Meadow-grass. Generic character: *calyx* two-valved, many-flowered; *corolla* two-valved; *valves* oval, though rather acute; *awnless*; *seed* covered by the corolla,

furrowed; *panicle* more or less branching or scattered.

POA *aquatica*, *per.* water meadow-grass, indig. July.

arundinacea, *per.* reed-like, nat. Caucasus.

maritima, *per.* sea meadow-grass, indig. July.

distans, *ann.* reflexed, indig. Summer.

fluitans, *per.* flote meadow-grass, indig.

rigida, *ann.* hard meadow-grass. May, indig.

procumbens, *ann.* procumbent meadow-grass, indig. July,
August.

dura, *ann.* harsh meadow-grass, nat. Germany. June.

pilosa, *ann.* hairy, nat. Germany. June.

eragrostis, *ann.* spreading, nat. Italy. July.

spicata, *ann.* spiked, nat. Portugal.

biflora, *ann.* two-flowered, nat. E. Indies.

miliacea, *per.* millet meadow-grass, nat. — ?

Molineri, *per.* Moliner's, nat. Piedmont.

concinna, *per.* violet-husked, nat. France.

collina, *per.* hill meadow-grass, nat. Germany.

Alpina brevifolia, *per.* short-leaved, nat. Greenland.

dissitiflora, *per.* distant-flowered, nat. Greenland.

gelida, *per.* frozen, nat. Greenland.

Cenisia, *per.* Mount Cenis, nat. Mount Cenis.

minor, *per.* smaller, nat. Switzerland.

Halleridis, *per.* Haller's, nat. Switzerland.

distichophylla, *per.* fan-leaved, nat. Alps.

gracilis, *per.* slender, nat. — ?

cespitosa, *per.* turfy, nat. New Zealand.

rhenana, *per.* nat. France.

Kitaibeli, *per.* Kitaibel's meadow-grass, nat. Syrmia.

Gaudini, *per.* Gaudin's, nat. Alps of Switzerland.

depauperata, *per.* thin-flowered, nat. Hungary.

pauciflora, *per.* few-flowered, nat. S. America.

sterilis, *per.* barren, nat. Tauriæ.

mulalensis, *per.* nat. S. America.

tristriata, *per.* thrice-striated.

sulcata, *per.* furrowed, nat. Virginia.

imbecilla, *per.* weak, nat. New Zealand.

anceps, *per.* fork-culmed, nat. New Zealand.

- POA flava*, *per.* yellow, nat. Virginia.
virgata, *per.* twiggy, nat. St. Domingo.
Mexicana, *ann.* Mexican, nat. Mexico.
hirsuta, *ann.* hairy, nat. Virginia.
capillaris, *ann.* capillary, nat. St. Domingo.
Indica, *ann.* Indian, nat. India.
plumosa, *ann.* feather-like, nat. Tranquebar.
Poiretii, *ann.* Poiret's, nat. cult. Paris gardens.
squarrosa, *ann.* squarrose, nat. C. G. Hope.
glomerata, *ann.* glomerate, nat. C. G. Hope.
effusa, *per.* scattered-panicled, nat. Hungary.
commutata, *per.* furrowed, nat. — ?
contracta, *per.* contracted-panicled, nat. India.
filiformis, *per.* slender-leaved, nat. C. G. Hope.
Amboinensis, *per.* crowded-panicled, nat. India.
cilianensis, *ann.* Piedmontese, nat. Piedmont.
Caroliniana, *ann.* Carolina meadow-grass, nat. N. Carolina.
latifolia, *per.* broad-leaved, nat. Java ?
Chinensis, *per.* Chinese, nat. — ?
hirta, *per.* roughish, nat. Japan.
Domingensis, *per.* St. Domingo, nat. St. Domingo.
Zea, *per.* intermediate meadow grass, nat. Santa Fe.
festucaformis, *per.* fescue-like, nat. Dalmatia.
convoluta, *per.* convoluted, nat. — ?
spinosa, *per.* spiny, nat. C. G. Hope.
sarmentosa, *per.* crowded-branched, culmed, nat. C. G.
 Hope.
striata, *per.* striated, nat. C. G. Hope.
racemosa, *per.* branching, nat. C. G. Hope.
pectinacea, *ann.* comb-valved, nat. N. America.
pallida, *ann.* pale, nat. — ?
scariosa, *per.* scariose, nat. *circa Gades*.
VahlII, Vahl's, nat. America.
subsecunda, *per.* nat. China.
bifaria, *per.* nine-inch-spiked meadow-grass, nat. E. Indies.
Coromandeliana, *per.* Coromandel, nat. coast of Coromandel.
bromoides, *per.* broom-like, nat. Lima ?
viscosa, *per.* viscous, nat. India.
Peruviana, *ann.* Peruvian, nat. Peru.

- POA carinata*, ann. keeled, nat. Port Rico.
stricta, ann. upright, nat. E. Indies.
elegans, ann. elegant, nat. Porto Rico.
Ægyptica, ann. Egyptian, nat. Egypt.
tenuiflora, ann. slender-flowered, nat. C. G. Hope.
squamata, ann. remote-panicled, nat. Brazils.
Virginica, ann. nat. Virginia.
aspera, ann. rough-peduncled, nat. Porto Rico.
Madagascariensis, ann. Madagascar, nat. Madagascar.
tremula, ann. tremulous, nat. Senegal.
unioloides, ann. uniola-like, nat. India.
glutinosa, ann. glutinous, nat. Jamaica.
punctata, ann. dotted, nat. Malabar.
barbata, ann. bearded, nat. Japan.
nutans, ann. nodding, nat. India.
cernua, ann. drooping, nat. E. Indies.
pallens, per. palish-coloured, nat. Buenos Ayres.
lanuginosa, per. woolly, nat. Monte Video.
sicula, ann. *Cynosurus sicula*, Jacq.
paradoxa, ann. nat. Van Diemen's.
rariflora, ann. scarce-flowering, nat. Rio.
subumbellata, per. sub-umbelled, nat. S. America.
remota, per. remote, nat. S. America.
dactyloides, per. cock's-foot-like, nat. S. America.
parvula, per. little, allied to *aira caryophylla*.
Borbonica, per. Bourbon, nat. Isle Bourbon.
Species from Brown's Prodr. Nov. Holland.

* Perianth, five-nerved.

** ———, three-nerved.

*** Spikes, one-sided.

- POA Australis*,* per. Southern, nat. Van Diemen.
lavis, per. smooth-sheathed, nat. Van Diemen.
plebeja, per. nat. about Port Jackson.
affinis, per. allied, nat. ibidem.
saxicola, per. nat. ibidem.
diandra,** per. diandrous, nat. ibidem.
venusta, per. beautiful, nat. ibidem.
leptostachya, per. nat. ibidem.
tenostachya, per. nat. ibidem.
pellucida, per. pellucid, nat. ibidem.

- POA speciosa*, *per.* specious, nat. ibidem.
pubescens, *per.* pubescent, nat. ibidem.
decipiens, *per.* unlike, nat. ibidem.
imbecilis, *per.* weak-stemmed, nat. ibidem.
abortiva, *per.* abortive-flowered, nat. ibidem.
digitata, *** *per.* digitate, nat. ibidem.
supina, *per.* weak-stemmed meadow-grass, nat. Germ.
laxa, *per.* wavy meadow-grass, indig.
alpina, *per.* alpine meadow-grass, indig. May.
bulbosa, *per.* bulbous meadow-grass, indig. April.
sudetica, *per.* broad-leaved, nat. Germ. July.
trivialis, *per.* rough-stalked meadow-grass, indig. June
till September.
cærulea, *per.* short blue, indig. May and June.
pratensis, *per.* smooth-stalked meadow-grass, indig. May
and June.
angustifolia, *per.* narrow-leaved, indig. May and June.
fertilis, *per.* fertile meadow-grass, nat. Germ. June and
July.
nemoralis, *per.* wood meadow-grass, indig. June and Aug.
nemoralis angustifolia, var. narrow-leaved wood meadow-
grass.
compressa, *per.* flat-stalked, indig. June till August.
compressa erecta, *per.* var. upright flat-stalked meadow-
grass.
annua, *ann.* annual meadow-grass, Suffolk-grass, indig.
February till January.
decumbens, *per.* decumbent, indig. July.
disticha, *per.* two-rowed, nat. Germ.
cæsia, *per.* sea-green meadow-grass, indig. July.
glaucæ, *per.* glaucous meadow-grass, indig. June, July.
nervata, *per.* nerved meadow-grass, nat. North America.
Abyssinica, *ann.* upright meadow-grass, nat. Abyssinia.
- ERAGROSTIS.** Spurious bent-grass. Generic character:
calyx from four to ten-flowered, valves shorter than the
corolla, imbricate; *corolla* superior valve reflex, margin
turned back, entire, ciliated, permanent; *germen* emar-
ginate; *seed* free, two-pointed; *panicle* compound, but
little scattered.

ERAGROSTIS *poacoides*, *per.**polymorpha*, *per.* various. *Poa polymorpha*.*verticillata*, *ann.* verticillate.*tenella*, *ann.* slender, *nat.* India.*ferruginea*, *ann.* iron-coloured, *nat.* Japan.*cynosuroides*, *ann.* dog's-tail-like, *nat.* Egypt.*cyperoides*, *ann.* cyperus-like, *nat.* C. G. Hope.*mucronata*, *ann.* mucronate, *nat.* E. Indies.*interrupta*, *ann.* interrupted-spiked, *nat.* N. Holland.

BRIZA. Quaking-grass. Generic character: *calyx* two-valved, many-flowered; *flowers* collected into heart-shaped spikelets; *corolla* two-valved, exterior valve the shape and size of the calyx husks, inferior valve smaller, flat, roundish; *seed* compressed.

elatior, *per.* tall, *nat.* Greece.*media*, *per.* common quaking-grass, *indig.* May and June.*geniculata*, *per.* knee-jointed, *nat.* C. G. Hope.*minor*, *ann.* small quaking-grass, *nat.* Brit. June.*maxima*, *ann.* great quaking-grass, *nat.* Italy. August.*humilis*, *ann.* dwarf, *nat.* Iberia.*virens*, *ann.* green, *nat.* Spain. August.*Monspensulana*, Montpellier, *nat.* France. July.*rubra*, *ann.* red, *nat.* India.

SPARTINA. Cord-grass. Generic character: *calyx* two-valved (three-valved R. S. L. Sys.), one-flowered, unequal, keeled, very acute; *corolla* two-valved, husks awnless; *bifid* emarginate, and toothed shorter than the calyx; *nectary* rather truncated, fringed; *styles* long, combined, separate above, stigma woolly; *seed* loose, covered by the corolla; *spikelets* pointing one way, inserted in double rows; *spike* compound.

cynosuroides, *per.* dog's-tail-like cord-grass, *nat.* N. Amer.*stricta*, *per.* upright cord-grass, *nat.* of England.*alterniflora*, *per.* alternate-flowered cord-grass, *nat.* Bayonne.*polystachya*, *per.* many-spiked cord-grass, *nat.* of New England.*pumila*, *per.* dwarf cord-grass, *nat.* circa Noveboracum.*juncea*, *per.* rush-like cord-grass, *nat.* of North America.

SPARTINA fasciculata, *per.* bundle-spiked cord-grass, nat. America.

geniculata, *per.* knee-jointed cord-grass, nat. Java.

DACTYLIS. Cock's-foot-grass. Generic character: *corolla* awned at the summit, lanceolate, keeled, compressed, inner valve folded, two-ribbed; *seed* loose, oblong; *calyx* compressed, taper-pointed, unequal.

glomerata, *per.* round-headed cock's-foot, indig. June and till August.

maritima, *per.* sea, nat. Germ. July.

cynosuroides, *per.* American cock's-foot, nat. N. America.

stricta, *per.* upright, indig. August.

patens, *per.* spreading cock's-foot, nat. N. America. July and August.

hispida, *ann.* hispid, nat. S. of Europe.

brachystachya, *ann.*

macilenta, *ann.* barren, nat. France.

glaucescens, *per.* glaucous, nat. Venice.

Hispanica, *per.* Spanish, nat. S. of Europe. July.

glauca, *per.* deep glaucous.

repens, *per.* creeping, nat. Africa.

lævis, *per.* smooth, nat. C. G. Hope.

ciliaris, *per.* ciliated, nat. C. G. Hope.

villosa, *per.* villous, nat. C. G. Hope.

serrata, *per.* serrated, nat. C. G. Hope.

hispida, *per.* hispid, nat. C. G. Hope.

memphitica, *per.* bristly-leaved, nat. Egypt.

lagopodoides, *per.* nat. Malabar.

brevifolia, *per.* short-leaved, nat. Malabar.

pungens, *ann.* pointed, nat. Barbary.

spicata, *ann.* spiked, nat. Barbary, in rice grounds.

ELYMUS. Lyme grass. Generic character: *calyx* lateral, two-valved, in twos or threes, many-flowered; *corolla* two-valved, spear-shaped, exterior acuminate or awned, interior valve smaller, flat, awnless; *seed* covered, convex on one side, and strap-shaped.

arenarius, *per.* sea lyme-grass, indig. July.

Europæus, *per.* barley-like lyme-grass, indig. June and July.

ELYMUS *geniculatus*, per. jointed lyme-grass, indig. July and August.

giganteus, per. tall lyme-grass, nat. N. America.

Sibericus, per. Siberian, nat. Siberia.

Philadelphicus, per. Philadelphian lyme-grass, nat. North America.

Canadensis, per. Canadian lyme-grass, nat. N. America.

Virginicus, per. Virginian lyme-grass, nat. Virginia.

striatus, per. striated lyme-grass, nat. N. America.

caput-medusæ, ann. Portuguese lyme-grass, nat. Portugal.

hystrix, per. rough lyme-grass, nat. Levant.

tener, per. tender lyme-grass, nat. Siberia.

sabulosus, per. gravelly, nat. Caucasus.

racemosus, per. nat. — ?

glaucofolius, per. grey-leaved, nat. America.

villosus, per. villous, nat. Virginia.

crinitus, ann. long-awned, nat. Hungary.

intermedius, ann. intermediate, nat. Iberia.

pauciflorus, ann. few-flowered, nat. — ?

junceus, per. rush-leaved, nat. Siberia.

hordeiformis, per. barley-like, nat. — ?

pilifer, per. nat. Aleppo.

Carolinianus? per.

subulatus? per. nat. Egypt.

mollis, per. soft-spiked lyme-grass.

FESTUCA. Fescue-grass. Generic character: *calyx* two-valved, many-flowered, containing the florets in a slender spike; *valves* acuminate, the interior the least; *corolla* two-valved, exterior valve larger than the calyx, acuminate or awned; *seed* acute at both ends, slender and oblong.

ovina, per. sheep's fescue, indig. May and June.

var. *a. violacea*, per. violet, indig. May, June.

var. *β. ovina hordeiformis*, per. long-awned sheep's fescue.

tenuifolia, per. slender-leaved, indig. May and June.

vivipara, per. viviparous fescue, indig. June.

nigrescens, per. blackish, nat. of Switzerland, Alpine pastures.

rubra, per. creeping-rooted, indig. June and July.

FESTUCA *Cambrica*, var. *per.* Welsh fescue, indig. a permanent variety.

var. *glabra*, *per.* smooth fescue, indig. June.

var. *dumetorum*, *per.* pubescent, indig.

duriuscula, *per.* hard fescue, indig. June and July.

var. *a. duriuscula* oliganthos, *per.* soft-leaved.

var. *β. duriuscula* polyanthus, *per.* mealy-rooted.

var. *γ. duriuscula* lævigata, *per.* smooth.

var. *δ. duriuscula* grandiflora, *per.* numerous-flowered.

bromoides, *ann.* brome-like fescue, indig. June and July.

myurus, *ann.* capon's-tail, or wall-fescue, indig. July.

uniglumis, *ann.* single-husked, indig. June and July.

calamaria, *per.* reed-like fescue, indig. June and July.

arundinacea, *per.* nat. Sweden? cult. by Mr. Taunton, Cheam, and also in Hort. Wob.

pratensis, *per.* meadow-fescue, indig. July.

elatioer sterilis, *per.* barren-seeded tall fescue.

elatioer fertilis, *per.* tall-fescue, indig. July.

cærulescens, *per.* bluish, nat. Barbary.

loliacea, *per.* darnel-like fescue, indig.

compressa, *per.* compressed, nat. France.

calycina, *ann.* bearded-leaved, nat. Spain.

unioloides, *ann.* uniola-like fescue; nat. N. America.

gigantea, *per.* gigantic fescue-grass, indig.

spadicea, *per.* Gerard's fescue, nat. Germ.

flavescens, *per.* yellow fescue, nat. Hungary. May.

littoralis, *per.* sea-side, nat. Greece.

pinnata, *per.* See *Bromus pinnatus*.

gracilis, *per.* See *Bromus sylvaticus*.

distachyos, *ann.* See *Bromus distachyos*.

monostachyos, *ann.* one-rowed, nat. Barbary.

cynosuroides, *ann.* dog's-tail-like fescue, nat. Barbary.

Fenas, *ann.* Fena, nat. Murcia, said to be excellent food for horses and mules.

capillata, *ann.* fine-leaved, nat. S. France.

intermedia, *per.* intermediate fescue, nat.—?

a. stricta, *per.* upright variety.

β. hirsuta, *per.* hairy-awned variety.

- FESTUCA Halleri*, per. Haller's, nat. Alps, Switzerland.
longifolia, per. long-leaved, nat. Italy.
curvula, per. curved-leaved, nat. Switzerland.
alpina, per. alpine, nat. Switzerland.
arenaria, per. sea-side, indig., sands, Skegness, Linc.
plebeja, per. short-jointed, nat. Van Diemen.
 var. *amethystina*, per. blue, indig. *F. tenuifolia*.
picta, per. painted, nat. Hungary.
reptatrix, per. creeping, nat. Arabia.
varia, per. various, nat. Alps of Europe.
Eskia, per. complicated-leaved, nat. Pyrennees.
glaucua, per. glaucous, nat. dry sandy soils.
pallens, per. pale, nat. Hungary, Austria.
pungens, per. pointed, nat. Alps.
Valesiaca, per. crowded-panicked, nat. Switz.
Pannonica, per. Hungarian, nat. Hungary.
Xanthina, per. light yellow, nat. Switz.
alpestris, per. wild, nat. Tyrol, sub Alps.
punctoria, per. dotted, nat. Greece.
heterophylla, per. various-leaved, nat. S. Alps, Europe.
vaginata, per. sheathed, nat. Hungary.
nutans, per. nodding, nat. America.
alopeucuros, ann. fox-tail-like, nat. Barbary.
ciliata, ann. ciliated, nat. Portugal.
blepharophora, per. broad-leaved, nat. E. Indies.
delicatula, ann. delicate, nat. Austria.
stipoides, ann. stipa-like, nat. Majorca.
Balearica, per. nat. Balearic Islands.
laxa, per. loose-panicked, nat. Switz.
scabra, per. rough, nat. C. G. Hope.
Mexicana, ann. Mexican, nat. Mexico.
pauciflora, ann. few-flowered, nat. Japan.
misera, ann. miserable fescue, nat. Japan.
Indica, ann. Indian, nat. Indian rice-grounds.
cespitosa, ann. turfy, nat. New Year Island.
andicola, ann. frigid, nat. S. America.
Tolucensis, per. Toluca, nat. S. America.
procera, per. tall, nat. S. America.

FESTUCA *quadridentata*, *per.* four-toothed, nat. S. America.

dasyantha, *per.* nat. at the confines of perpetual snow on Mount Cotopaxi.

phalaroides, *per.* phalaris-like, nat. France.

grandiflora, *per.* great-flowered, nat. Carolina.

flabellata, *per.* waving, nat. Straits of Magellan.

arenaria, *per.* sand, nat. Straits of Magellan.

capillifolia, *per.* fine-leaved, nat. fissures of rocks near Moxente.

montana, *per.* mountain, nat. Mount Pisano.

fallax, *per.* uncertain, nat. about Paris.

compacta, *per.* compact, nat. Aleppo.

glomerata, *per.* glomerate, nat. Aleppo.

bracteata, *per.* bracteated, nat.—? Cult. in gardens.

patula, *per.* spreading, nat. Barbary.

obtusa, *per.* obtuse, nat. America.

latifolia, *per.* broad-leaved.

quadridens, *per.* four-toothed, nat. America.

pulchella, *per.* fair. nat. Germ.

nutans, *per.* nodding, paniced, nat. Germ.

aurata, *per.* pale yellow, nat. Switzerland.

nigrescens, *per.* blackish, nat. Switzerland.

poæformis, *per.* meadow-grass-like, nat. France and Switzerland.

Americana, *per.* American, nat. near the river St. Lawrence.

pumila, *per.* dwarf, nat. Europe.

nitida, *per.* shining, nat. Alps.

littoralis, *per.* sand, nat. Van Diemen.

spicata, Pursh, *per.*? spiked, nat. Amer. watery places.

tenella, Pursh, *ann.* eight or nine-flowered, nat. America.

Bonariensis, *ann.* Buenos Ayres, nat. S. America.

triflora, *ann.* three-flowered.

BROMUS. Brome-grass. Generic character: *calyx* two-valved, many-flowered, valves ovate-oblong: *corolla* two-valved, valves spear-shaped; exterior valve concave, obtuse, bifid, putting out a straight awn below the top or apex; *seed* oblong, covered.

mollis, *ann.* soft annual brome-grass, indig.

- BROMUS** *multiflorus*, ann. many-flowered brome-grass, indig. June and July.
secalinus, ann. smooth ray brome-grass, indig. June and July.
arvensis, ann. field brome-grass, indig. July.
lanceolatus, ann. spear brome-grass, nat. coast of the Caspian Sea.
squarrosus, ann. corn brome-grass, indig. July.
purgans, ann. purging brome-grass, nat. Canada. July.
inermis, per. smooth awnless brome-grass, nat. Germ. July.
asper, ann. hairy wood brome-grass, indig. July and August.
littoreus, ann. sea-side brome-grass.
sterilis, ann. barren brome-grass, indig. June and July.
erectus, per. upright brome-grass, indig. June.
strictus, per. straight, nat. Europe.
tectorum, ann. nodding brome-grass, nat. Germ. June.
rubens, ann. Spanish brome-grass, nat. Spain. June.
racemosus, ann. branching brome-grass, indig. June.
diandrus, ann. upright annual brome-grass, indig. July.
sylvaticus, per. wood brome-grass, indig. August.
pinnatus, per. spiked brome-grass, indig. July.
rupestris, per. rock, nat. Germany.
cespitosus, per. turfy, nat. Germany.
ramosus, per. branching.
distachyos, ann. two-rowed brome-grass, nat. Germany.
Phœnicoides, per. Phœnician, nat. France.
giganteus, per. tall or gigantic brome-grass.
elongatus, ann. elongated, nat. Switzerland, rare.
commutatus, ann. altered, nat. Europe. July.
Gaudini, ann. Gaudin's, nat. Switzerland.
simplex, ann. simple paniced, nat. —?
confertus, ann. heaped paniced, nat. Iberia.
Biebersteinii, per. Biberstein's, nat. Caucasus.
Canadensis, per. Canadian, nat. Canada.
pectinatus, per. comb, nat. C. G. Hope.
arenarius, per. sand, nat. N. Holland.
Australis, per. Southern, nat. N. Holland.

BROMUS *lanceolatus*, ann. spear-leaved, nat. Canaries.

lanuginosus, ann. woolly, nat. France.

wolgensis, ann. large spikeleted, nat. S. of France.

laxus, per. loose-panicled, nat. — ?

Japonicus, ann. Japan, nat. Japan.

macrostachyus, ann. nat. Africa.

alopecuroides, ann. fox-tail, nat. — ?

pubescens, per. pubescent, nat. Pennsylvania.

catharticus, per. cathartic, nat. Lima.

pendulinus, ann. pendulous, nat. N. Spain.

glaucus, per. glaucous, nat. Pyrennees.

montanus, per. mountain.

longiflorus, ann. long-flowered. August.

verticillatus, ann. whirled-panicled, nat. Arragon.

pallens, ann. pale-coloured, nat. Manilla.

ciliatus, per. ciliated, nat. Canada.

segetum, ann. marshy, nat. S. America.

pitensis, ann. tufty-culmed, nat. S. America.

ligusticus, ann. tongue-panicled, nat. Italy.

Micheli, ann. Michel's, nat. Florence.

multispicatus, ann. many-spiked, nat. Spain.

pilosus, per. pilose, nat. S. of Europe.

jubatus, per. bearded, nat. Virginia.

maximus, ann. great-spiked, nat. France.

geniculatus, ann. jointed, nat. Portugal.

rigens, ann. nat. Portugal.

hordeiformis, ann. barley-like, nat. Portugal.

scoparius, bien. broom, nat. Spain.

* *Doubtful Species.*

avenaceus, bien. oat-like. Has the habit of *Avena pratensis*.

poæformis, ann. poa-like, nat. America,

festucoides, ann. fescue-like, nat. Portugal.

tomentosus, ann. tomentose. Rhode.

hirtus, ann. hairy.

dactyloides, ann. cock's-foot-like.

polystachyus, ann. many-rowed.

jubatus, ann.

Phænix, ann.

massiliensis, ann.

BROMUS *scaberrimus*, ann. roughish-flowered, nat. Italy.

lividus, ann. bright lead-coloured, nat. S. America.

lanatus, ann. woolly, nat. S. America.

procerus, ann. tall.

unioloides, ann. uniola-like, nat. America.

caldasii, ann. hot-water brome.

AVENA. Oat-grass. Generic character: *calyx* two-valved, many-flowered, florets loosely collected; *corolla* two-valved, valves spear-shaped, exterior valve awned: awn from the back of the valve twisted and jointed; seed covered firmly by the corolla husk.

provincialis, ann. Provence oat-grass, nat. France.

strigosa, ann. meagre oat-grass, indig. June.

brevis, ann. short, nat. Germany. June.

alba, per. white, nat. France.

sterilis, ann. barren oat, nat. Germany.

hirsuta, ann. hairy, nat. —?

Orientalis, ann. Turkey oat, nat. Germany. July.

elephantina, ann. nat. C. G. Hope.

nuda, ann. naked or pilcorn, indig. July. Cultivated occasionally.

fatua, ann. bearded oat, or haver, indig. August.

tenuis, ann. slender oat, nat. Germany. June.

sativa nigra, ann. cultivated black oat. July and August.

sativa alba, ann. cultivated white oat. July.

sativa Georgiana, Georgian oat.

Pennsylvanica, ann. Pennsylvanian oat, nat. North America.

Siberica, ann. Siberian oat, nat. Siberia.

Loefflingiana, ann. Spanish oat, nat. Spain. July.

fragilis, ann. brittle, nat. Germany and Spain. June.

sempervirens, per. evergreen oat; nat. Germ. June.

fallax, per. fallacious, nat. Pyrennees.

flavescens, per. yellow oat, golden oat, indig. June and July.

pratensis, per. meadow oat, indig. June and July.

pubescens, per. downy oat, indig. June and July.

alpestris, per. rock oat, nat. Germany. August.

brevifolia, per. short-leaved, nat. Germany.

AVENA distichophylla, *per.* fan-leaved, nat. Germany.
May and June.

planiculmis, *per.* broad-stalked, indig. July and August.

versicolor, *per.* various-coloured oat, nat. Germ. August.

spicata, *per.* spiked, nat. Carolina.

lupulina, *per.* lupine, nat. C. G. Hope.

purpurea, *per.* purple, nat. Martinico.

calycina, *per.* shining-husked, nat. C. G. Hope.

setacea, *per.* bristly, nat. New Holland.

pauciflora, *per.* few-flowered, nat. New Holland.

paradoxa, *per.* doubtful, nat. Port Jackson.

longifolia, *per.* long-leaved, nat. Port Jackson.

pallida, *per.* pale, nat. Port Jackson.

pilosa, *per.* pilose, nat. Port Jackson.

glauca, *per.* glaucous, nat. Mount d'Esquierry.

striata, *per.* striated, nat. America.

pallens, *per.* pale, nat. Portugal.

amethystina, *ann.* blue, nat. France.

subulata, *ann.* alpine, nat. France.

palustris, *ann.* marsh, nat. Carolina.

hispida, *ann.* hispid, nat. C. G. Hope.

bromoides, *ann.* brome-like, nat. Spain.

caryophylla, *per.* pink-leaved, nat. Greece.

latifolia, *per.* broad-leaved, nat. Germany.

pumila, *ann.* dwarf, nat. Mascar.

mollis, *ann.* soft-downy, nat. Canada.

quadrisseta, *ann.* four-awned.

nervosa, *ann.* nerved, nat. Van Diemen.

antarctica, *ann.* antarctic, nat. C. G. Hope.

Cavanillesii, *ann.* Cavanille's, nat. Spain and Portugal.

hirtula, *ann.* small hairy, nat. —?

filifolia, *per.* slender-leaved, nat. Spain.

scabriuscula, *ann.* roughish, nat. Germany.

coquimbensis, *ann.* pilose-flowered, nat. S. America.

neglecta, *ann.* neglected, nat. Italy and Spain.

trisetum, *ann.* villous, nat. C. G. Hope. *Trisetum villosum*, *ibid.*

Forskali, *ann.* Forsk's, nat. Egypt.

- AVENA trisetaria*, ann. small-linear, nat. Egypt.
lutea, ann. yellowish, nat. Martinico.
parviflora, ann. small-flowered, nat. Italy, Africa.
micrantha, ann. minute-flowered, nat. Europe.
alopecuroides, ann. fox-tail-like, nat. — ?
panicea, ann. bearded-sheathed, nat. Oporto.
Pourreti, ann. hispid-awned, nat. Spain.
rigida, per. rigid, nat. Caucasus.
carpathica, per. creeping-rooted, nat. Germany.
fusca, per. dark-brown, nat. Germany.
aristidioides, per. nat. C. G. Hope.
arenaria, per. sand, nat. Damascus, in sandy places.
macra, per. meagre, nat. Iberia.

CYNOSURUS. Dog's-tail grass. Generic character :
calyx two-valved, two to five-flowered ; *corolla* two-valved, valves linear, spear-shaped, exterior awnless, or with an awn terminating the apex ; *seed* covered by the corolla, the spikelets in most species with leaflets on one side (*involucre*), or husks on a leaf-stalk (*stipata*).

cristatus, per. crested dog's-tail grass, indig. June and July.

- multibracteatus*, per. many-bracteated, nat. Barbary.
paniculatus, per. panicled, nat. C. G. Hope.
uniolæ, per. uniola-like, nat. C. G. Hope.
floccifolius, per. alternate bearded-leaved, nat. Arabia.
ternatus, per. three-spiculed, nat. Arabia.
uniflorus, per. one-flowered, nat. Carolina.
lagopoides, per. leafy-culmed, nat. — ?
virgatus, ann. twig, nat. S. America.
Domingensis, per. nat. St. Domingo.
tenerrimus, ann. tender, nat. China.
monostachyus, ann. one-rowed, nat. E. Indies.
filiformis, ann. slender, nat. India.
falcatus, per. hooked-spiked, nat. C. G. Hope.
gracilis, ann. slender one-rowed, nat. Virginia.
hirsutus, ann. hairy, nat. C. G. Hope.
trisetus, ann. three-awned, nat. Mexico.

CYNOSURUS *paspaloides*, paspalum-like, nat. C. G. Hope, Jamaica, America.

submuticus, ann. scarce-awned, nat. S. America.

Indicus, ann. Indian, nat. India.

mucronatus, ann. mucronate, nat. N. America.

racemosus, ann. branching, nat. India.

echinatus, ann. rough-spiked, indig. June.

Lima, ann. imbricated, nat. Spain. July.

coracanus, ann. thick-spiked, nat. East Indies. August.

aureus, ann. golden dog's-tail grass, nat. Germany.

erucæformis, per. linear-spiked, nat. Germany.

Ægypticus, ann. creeping, nat. Africa and Asia.

CHLORIS. Green-finch grass. Generic character : *florets* pointing one way, three to six-flowered, terminating floret incomplete or abortive ; *calyx*, valves membranaceous, permanent ; *corolla*, valves emarginate, inferior one quadrifid between the lobes, bristled on the back midway ; *spikelets* filiform, four or more.

* *Species one-flowered.*

panicea, per. panic-like, nat. E. Indies.

foliosa, per. leafy, nat. Porto Rico and the Island of St. Thomas.

ciliata, ann. ciliated, nat. Jamaica.

radiata, ann. rayed, nat. S. America., in cultivated ground.

incompleta, ann. incomplete, nat. E. Indies.

pallida, ann. pale, nat. S. of France.

barbata, ann. bearded, nat. E. Indies.

polydactyla, ann. bundled-spiked, nat. S. America.

elegans, ann. elegant, nat. S. America.

compressa, ann. compressed, nat. S. of France.

pubescens, ann. pubescent, nat. Peru.

ventricosa, ann. ventricose, nat. Port Jackson.

truncata, ann. truncated, nat. Port Jackson.

divaricata, ann. divaricated, nat. N. Holland.

pumilio, ann. dwarfish, nat. N. Holland.

** *Species many-flowered.*

penicillata, ann. pencilled, nat. East Indies.

CHLORIS *prostrata*, ann. prostrate, nat. Malabar.

tetrapogon, ann. nat. Cassam.

elongata, ann. elongated, nat. Timor.

filiformis, ann. slender, nat. — ?

distichophylla, per. two-rowed, nat. S. America.

retusa, per. retuse-husked, nat. S. America.

dolichostachya, per. loose-bundled, nat. Philippine Isles.

crinita, ann. long-awned, nat. Philippine Isles.

rufescens, ann. reddish, nat. Philippine Isles.

gracilis, per. slender, nat. S. America.

digitaria, ann. fingered, nat. S. America.

dubia, per. doubtful, nat. S. America.

EUSTACHYS. Eustachys. Generic character: *calyx* two-valved, two-flowered, inferior valve ovate, emarginate, awn bristly; *awn* dorsal oblique, superior husk acute; *corolla* unisexual, floret sessile, two-valved, awnless, inferior husk mucronate, superior acute, nearly bifid; bisexual floret sub-pedicelled, terminating, husks obtuse, awnless, sessile; florets spiked, fingered. See *Cynosurus*.

DIPLACHNE. Diplachne. Generic character: *calyx* seven-nine-flowered, apex of the superior valve mucronate; *corolla*, inferior valve bilacinate, bristly between the lobes or lacines, superior subtruncated, emarginate; panicle simple, branching, branches alternate, slender, or filiform.

fascicularis, ann. bundled, nat. America, Illinois.

fusca, ann. brown, nat. Egypt.

ENNEAPOGON. Nine-bristled grass. Generic character: *spikelets* scattered, two-three-flowered; *calyx*, valves longer than the flowers, inferior less; *corolla*, exterior valve with nine bristles, nearly equal, margins bearded, superior valve awnless, entire, rather obtuse; *style* two-parted; *spike* simple.

gracilis, ann. slender, nat. N. Holland.

purpurascens, ann. purple, nat. N. Holland.

pallidus, ann. pale, nat. N. Holland.

nigricans, ann. blackish, nat. N. Holland.

ENNEAPOGON *phleoides*, ann. cat's-tail, nat. S. America?

TRIRAPHIS. Generic character: *calyx* two or many-flowered, superior floret neuter; *corolla*, inferior valve with three straight awns rising from the apex, superior awnless; *panicle* compound; *spikelets* two-rowed.

pungens, ann. pungent, nat. N. Holland.

mollis, ann. soft, nat. N. Holland.

KOELERIA. Koeleria. Generic character: *calyx* two-valved, two-five-flowered, florets shorter; *corolla* two-valved, inferior entire, bristled, superior bifid; *panicle* spike-like, branches heaped.

cristata, per. crested. indig.

var. β . *cristata pyramidalis*, pyramidal.

var. γ . *cristata gracilis*, slender.

var. δ . *cristata grandiflora*, larger-flowered.

var. ϵ . *cristata violacea*, violet-coloured.

lobata, per.

glauca, per. glaucous. *Aira glauca*.

Pennsylvanica, per. Pennsylvanian, nat. America.

albescens, per. whitish-coloured, nat. France.

Valesiaca, per. smooth-culmed, nat. Switzerland.

setacea, per. bristly, nat. Spain. *Koeleria tuberosa*, *festuca splendens*, et *poa pectinata* auctorum.

hirsuta, ann. hairy, nat. France.

villosa, ann. villous, nat. Sweden.

phleoides, per. cat's-tail, nat. N. of Europe.

*hispid*a, ann. hispid, nat. coast of the Mediterranean.

brachystachya, ann. nat. — ?

macilenta, ann. nat. France.

AGROPYRUM. Agropyrum, or spurious wheat. Generic character: three-nine-flowered, valves acute, shorter, entire; *corolla*, inferior valve entire, sometimes a little toothed, apex bristled, the bristles often very short, or wanting, superior valve emarginate or two-dented; *spike* compound, rachis jointed, indented; *spikelets* sessile, or on very short foot-stalks.

acutum, per. acute-husked spurious wheat, nat. France.

attenuatum, per. attenuated, nat. S. America.

AGROPYRUM *rigidum*, per. rigid, nat. Bohemia.

var. *α. scabria*, per. rough-husked.

var. *β. lævibus*, per. smooth-husked.

var. *γ. pilosus*, per. pilose-leaved.

var. *δ. subnervibus*, per. plain-husked.

glaucum, per. glaucous, nat. Germany.

obtusiflorum, per. nat. — ?

pungens, per.

densiflorum, per. dense-flowered, nat. Siberia.

giganteum, per. gigantic.

repens, per. couch-grass.

Varieties of Couch grass.

α. subulatum, per. awl-husked.

β. dumetorum, per. Wood.

γ. Vaillantianum, per. short-awned.

δ. Leersianum, per. two or three spiculed.

ε. capillare, per. hair-awned.

η. imbricatum, per. imbricated.

Sibiricum, per. Siberian.

caninum.

vaginans, per. sheathing, nat. S. America.

distichum, per. two-rowed, nat. C. G. Hope.

prostratum, per. prostrate, nat. arid deserts, Africa.

Oriente, ann. Eastern, nat. Eastern Archipelago.

imbricatum, per. imbricated, nat. Caucasus.

cristatum, per. crested.

scabrum, per. rough, nat. Van Diemen's Land.

pectinatum, per. comb-like, nat. Van Diemen.

variegatum, per. variegated, nat. — ?

* *Doubtful species.*

filiforme, per. slender.

bicorne, ann. two-horned, husked, nat. Egypt.

biflorum, ann. two-flowered, nat. — ?

subulatum, ann. awl-husked, nat. Aleppo.

Peruvianum, per.

TRITICUM. Wheat-grass. Generic character: *calya*, a common receptacle elongated into a spike, husks two valves, many-flowered; *corolla* two-valved, spear-shaped,

exterior valve ventricose, obtuse, with a point or an awn; the interior valve flat; *seed* ovate, oblong, at both ends obtuse, convex on one side and furrowed on the other.

TRITICUM caninum, *per.* bearded perennial wheat-grass, indig. July.

glaucescens, *per.* glaucous pilose-leaved, indig.

elongatum, *per.* long-spiked, nat. Germany. July.

juncum, *per.* rush-leaved, indig. July. *Agropyrum junceum*.

cristatum, *per.* crested wheat-grass. July.

lohiaceum, *ann.* darnel-like wheat-grass, indig. June and July.

tenellum, *ann.* dwarf wheat-grass, nat. Spain. July.

æstivum, *ann.* spring wheat, nat. unknown.

hybernium, *ann.* Lammas wheat, nat. unknown.

1. var. *muticum*, *ann.* red Lammas wheat, nat. unknown.

2. var. *spica et granis rubentibus*, red, or Kentish wheat.

3. var. *spica et granis albis*, white wheat.

4. var. *aristis munitum*, red-eared bearded wheat.

5. var. *album*, white-eared bearded wheat.

In R. S. Linn. Sys. Veg. the following arrangement of the varieties of *triticum æstivum* occurs.

1. *Varieties with smooth ears and awnless spikelets or ears.*

a. *Trit. vulgare autumnale*, with white spikes and yellow corn.

b. —————, with yellowish red ears and yellow corn, grain larger than in var. a.

c. a. *Trit. vulgare autumnale*, with white ears and white grain, seed almost round.

c. b. *Trit. vulgare autumnale*, with longer and more transparent grain.

d. a. *Trit. vul. vernum*, spike yellowish-red, smaller than var. b.

d. b. —————, with grain much larger, culms more slender.

c. a. *Trit. vulg. vernum*, spike short, four-angled, reddish-brown.

c. b. —————, spike whitish.

2. *Varieties with smooth spikes, and awned.*

- f. a. *Trit. vulg. autumnale*, spike reddish-brown, awn deciduous when ripe, seed large, culms feeble, husks glaucous, plum-coloured.
- f. b. *Trit. vulg. autumnale*, spike white, shorter, culms less and feeble.
- g. a. *Trit. vulg. autumnale*, spike white, fleshy, somewhat four-angled, awns partly deciduous.
- g. b. *Trit. vulg. vernum*, awns long, straight, spike short.
- h. a. ——— *autumnale*, spike white, ruffous, compact ; awns divaricate, permanent.
- h. b. *Trit. vulg. autumnale*, spikes, awns reddish-brown, divaricate.
- h. y. *Trit. vulg. autumnale*, spikes shorter.
- i. a. ———, spikes ruffous, compact, awns crowded, ruffous.
- i. b. *Trit. vulg. autumnale*, spikes short, thick (similar to *Triticum compositum*).
- k. *Trit. vulg. autumnale*, spike white, fleshy, awns black, seed white, large, and turgid.
- l. a. *Trit. vulg. autumnale*, spike white, rather slender, awns black, culms slender, weak.
- l. b. *Trit. vulg. autumnale*, spike whitish, awns black, culm slender, hollow, husks shining.

3. *Spikes villose, awnless.*

- m. *Trit. vulg. autumnale*, spikes awnless, villose, grey, culms hollow, seed golden colour, bearded at one end.

4. *Spikes bearded, villose.*

- n. a. *Trit. vulg. autumnale*, spike ash-blue coloured, villose, awns black, spike slender, culms feeble, seed convex, awns often deciduous when ripe.
- n. b. *Trit. vulg. autumnale*, awns greyish-brown, spike small, bluish.
- n. y. *Trit. vulg. autumnale*, spikes and awns whitish-ash coloured.
- o. a. *Trit. vulg. autumnale*, spike short, fleshy, turgid, awned, brownish, culm feeble.

- o. b. *Trit. vulg. autumnale*, spikes and awns whitish.
 p. *Trit. vulg.* Spike fleshy, large, somewhat ash-coloured, long-awned, seed horny-hard, culm feeble.
fastuosum, ann. long pyramidal spiked. Cult. S. Spain.
Gaertnerianum, ann. Gaertner's. Cult. Spain.
platystachyum, ann. compressed-spiked. Cult. ibid.
cochleare, ann. spoon-shaped. Cult. ibid.
Cevallos, ann. Cevallo's. Cult. ibid.
durum, ann. hard-grained. Cult. Barbary.
siculum, ann. small dagger-form. Cult. Sicily, Asia.
hordeiformis, ann. barley-like. Cult. Austria.
compactum, ann. close-headed. Cult. Styria.
atratum, ann.

* *Species with leafy husks.*

Polonicum, ann. (which see).

2. *Species with the hardened calyx holding the ripe seed.*

* *Spikes opposite, compressed.*

monococcum, ann.

cienfuegos, ann. Cult. Austria.

Bauhini, ann. Bauhini's.

** *Species with compressed even spikes.*

Uncultivated or wild species.

Hispanicum, ann. Spanish.

squarrosus, ann. angular, nat. Egypt.

villosus, ann.

campestre, ann.

Creticum, ann. Crete, nat. Crete and Corsica.

spinulosus, per. spine-leaved.

Ægilops, ann. nat. Georgia. Levant.

compositus, ann. many-spiked wheat.

turgidus, ann. Barbary wheat.

Linnæanum, ann. simple-spiked.

var. 1. *quadratum*, ann. cone-wheat.

Polonicus, ann. Polish wheat.

Spelta, ann. Spelt wheat.

var. *zea amylacea*.

monococcum, ann. one-grained wheat.

The *festuca myurus*, having but one stamen, stands an exception to this arrangement.

This Catalogue contains about one thousand five hundred distinct species and varieties of the proper grasses, of which, upwards of one hundred and fifty are indigenous to Great Britain; but, as the discoveries of botanists still continue to add to the number of new species and varieties, the term *complete* cannot be applied to this enumeration. The highly valuable and important works of Sir James Edward Smith, of Brown, Humboldt and Bonpland, Decandolle, Poiret, La Gasca, and other eminent botanists, have of late presented to the attention of the agriculturist many new species of grasses.

CHAPTER II.

OF THE GRASSES AND OTHER PLANTS WHICH CONSTITUTE THE PRODUCE OF THE RICHEST NATURAL PASTURES.

It has long been a prevailing opinion, that rich pasture land, when once broken up for a course of crops, cannot for a great length of time be again brought to so good a sward ; and this opinion is founded on the best grounds—on experience. The causes why those grasses, which constitute this valuable sward, cannot be renewed in as great perfection after a few years' removal from their natural soil, must either be, that these plants require many years to attain to that degree of productiveness; or, that the soil has been too much deteriorated by the crop, or course of grain crops, taken previous to renewing the grasses; or, lastly, that the seeds of grasses different from those which composed the valuable sward, have been employed in their stead. Whether to one, or all of these points, the want of success is to be imputed, it is of importance to inquire.

Grasses, like all other vegetables, possess a peculiar life, in which various periods may be distinctly marked. Some species of grass are annual, or arrive at perfection in one year, and then die away: as different species of brome-grass, fox-tail grass, ray-grass, oat-grass, &c. Other species, in two or three years attain to that degree of perfection which they never exceed: as perennial ray-grass (*lolium perenne*), rough meadow-grass (*poa trivialis*), meadow cat's-tail-grass (*phleum pratense*), tall oat-like soft-grass (*holcus avenaceus*), round cock's-foot-grass (*dactylis glomerata*), &c.; and there are but few grasses that require more than three years to bring them to that state of productiveness which they never exceed, if properly treated during that time: meadow fescue

(*festuca pratensis*), meadow fox-tail (*alopecurus pratensis*), meadow barley (*hordeum pratense*), smooth meadow-grass (*poa pratensis*), and meadow oat-grass (*avena pratensis*), are of this number. These facts, obtained from the results of experiments and attentive observation, made on these grasses when cultivated singly, and also when combined with others, as in their natural places of growth, offer sufficient proofs to decide, that it is not to the great length of time they require to arrive at perfection that the want of success, in attempts to renew rich pastures, is to be imputed.

On converting this land into tillage, the first crops are generally too luxuriant. Were we to conclude, from this circumstance, that the superior pasture grasses require a much richer soil to produce them in perfection than what is required for the production of grain crops; and, consequently, that a course of white crops, by lessening considerably this degree of fertility, would proportionally render the land less fitted for the reproduction of its former valuable grasses, it would not be just; because it is evident that this over-richness of the land for the first crops of grain, does not arise solely from *that degree of richness* in the soil which produced the superior grasses in *such abundance*, but rather from the accession of so large a quantity of vegetable matter, which is at once supplied to the land by ploughing in the turf.

Having met with no specific information in any agricultural works within my reach respecting the change produced on the nature of rich pasture land by a course of grain crops, I made several experiments to supply the apparent defect. The results of one of these experiments I may be permitted to detail.

A space of two square yards of rich ancient pasture land was dug to the depth of the surface soil, which was eight inches, and removed to a place more convenient for making the experiment, but placed on a subsoil of the same nature as that on which it was before incumbent. Three inches from the bottom of the mass were first placed on the subsoil, and the turf was then reversed on this, to the depth of five inches: this mode was adopted, to place the ground

under circumstances as similar as possible to that of ploughing it five inches deep, in the usual manner of breaking up pasture land.

The nature of the soil was now ascertained, by taking up a portion of it to the full depth, only rejecting the green living vegetable parts of the turf.

400 grains, freed from moisture and the plants of grass, consisted of—

Calcareous and siliceous sand, of different degrees of fineness	102 grains.
Decomposing vegetable matter, and particles of roots.....	55
Carbonate of lime, or chalk.....	160
Silica, or earth of flint.....	50
Alumina, or pure matter of clay.....	25
Oxide of iron.....	4
Soluble vegetable matter, and gypsum....	4

The soil was then cropped for five seasons alternately, with, first, oats; second, potatoes; third, wheat; fourth, carrots; and fifth, wheat—to the end that it might suffer as much as could possibly happen, under ordinary circumstances, by an impoverishing or injudicious rotation of annual crops. Every trace of the turf was by this time entirely lost in the general mass of the soil, which was now examined, to ascertain what change it had undergone by these crops. It appeared to consist of—

Calcareous and siliceous sand, nearly as before.....	100 grains.
Decomposing vegetable matter, destructible by fire	48
Carbonate of lime, or chalk, nearly as before	159
Silica, or earth of flint.....	57
Alumina, or pure matter of clay.....	26
Oxide of iron	5
Soluble vegetable and saline matter.....	3

The above details show, that very little, if any change,

had taken place in the constitution of the soil, in respect of its earthy ingredients : but a very considerable diminution of its decomposing vegetable and animal matters ; particularly when it is considered how great an addition had been made to the original proportion it contained of this constituent, by the turf, which was incorporated with the soil.

The finely-divided animal and vegetable matters of soils are so intimately blended with the other constituents, that manure, though applied in sufficient quantity to supply the loss, requires considerable time to bring its parts into that minute state of division, in which it was found in the rich pasture land, on the first examination before mentioned. It is evident the fine divided vegetable matter of the pasture land had been added to it (as it is indeed to all other pasture lands), by manure successively applied to the surface, either by the cattle which grazed upon it, or by top-dressing, and divided and carried into the soil by the action of rain. That this essential ingredient of the fertility of soils is exhausted, even by the growth of the grasses, when the annual supply of manure is suspended, is shown by daily experience ; as in the instance of mowing a pasture for several seasons successively without any top-dressing, or depasturing with cattle : the produce of grass is found to decrease annually, and if the practice be long continued, it will require nearly as many years, under the best management, to bring the pasture to as productive a state as it was previous to the suspension of its annual supply of surface manure. This likewise shows, that pasture land arrives at a certain degree of productiveness which it never exceeds, but at the expense of the quality of its produce ; as the surface becomes unequal, the grass rank, of a coarse nature, and less grateful to cattle. In this case (which does sometimes happen), the grass may be brought back to its nutritive state, by stocking the pasture sufficiently with different cattle in succession, throughout the season ; the insufficiency of which seems to be the principal cause of the evil. But when such plants as knapweed (*centaurea nigra*), different species of ragwort, hawkweed, thistle, and sow-thistle, &c. that are of no value as food for cattle, have established themselves in these pastures,

from sheer neglect; the remedy of hard-stocking, and even weeding, will be found inadequate to extirpate these unprofitable plants. But to return to the details of the experiment.

The results of the last chemical examination of the soil had shown, that it had lost a very considerable portion of its decomposing vegetable and animal matters. To supply this deficiency in some measure, manure was now, for the first time, applied, and, with the wheat stubble, dugged in to the depth of six inches; the surface was then made fine with a rake, and sown with a mixture of the following grass seeds, at the rate of *five* bushels to the acre.

Festuca pratensis (meadow fescue), *alopecurus pratensis* (meadow fox tail), *dactylis glomerata* (round cock's foot), *holcus avenaceus* (tall oat-like soft grass), *vicia sepium* (creeping vetch), *lolium perenne* (ray grass), *phleum pratense* (meadow cat's tail), *cynosurus cristatus* (crested dog's tail), *avena flavescens* (yellow oat), *avena pratensis* (meadow oat), *festuca duriuscula* (hard fescue), *poa trivialis* (smooth-stalked meadow grass), *poa fertilis* (fertile meadow grass), *poa nervata* (nerved meadow grass), *trifolium medium* (cow clover), *trifolium repens* (Dutch or white clover), *agrostis stolonifera* (creeping-stemmed bent, or florin), and *agrostis palustris* (marsh bent).

The seeds of the six first mentioned grasses being larger than the others were first mixed and sown, and covered with a rake; the rest of the seeds were mixed and sown, and pressed in with a roller, making all smooth and firm. This was finished on the 23d of August, 1813.

The seeds of all vegetated before the first week of October, except the seed of the *vicia sepium*, which did not vegetate till the autumn of the succeeding year. Before the frost set in, these seedling grasses had a top-dressing, with compost of rotten dung, lime, and vegetable mould, laid on in a fine and dry state, after which the surface was again rolled; in the month of February this was repeated, when the ground was sufficiently dry for the purpose. The plants sprung earlier than those of the old pasture (a circumstance common to young plants in general). In April, the weeds which had

been brought in the compost were carefully cleared out ; and the rolling was repeated to keep the surface compact. The plants grew vigorously, until a continuance of unfavourable weather, in the end of June, checked their growth. On the first week of July the produce was cut and weighed : it amounted to one-eighth more than the produce of the ground in its original state, but which had been eaten off by sheep in the spring ; the after-math of the seedling grasses, however, weighed one-fifth less than that of the natural pasture. A very slight dressing was applied in the month of November, and the whole was well rolled ; this operation was continued at favourable opportunities, till April, 1815. The grass was cut and weighed in the first weeks of June and August, and again in the middle of September ; the total weight of these three crops exceeded that of the old turf, exactly in the proportion of 8 to 9.

It is therefore evident, that the results of the two modes of experiment here adopted agree in confirming the opinion, that a five years' course of the more impoverishing annual crops may be taken from land of the nature above described, without unfitting it for the reproduction of the superior natural grasses.

The first, or that of ascertaining the nature of the soil before and after undergoing the impoverishing course of crops, proves, that the loss of decomposing animal and vegetable matter, is the principal injury it sustained, which it is evident may be supplied by manure, though not in one season. The produce of the different annual crops, grain, and bulbs, were all heavy, except that of the last crop of wheat, which was very inferior.

The different grasses and other plants, which compose the produce of the richest natural pastures, are in number twenty-five. From the spring till the end of autumn, there is not a month but is the season of luxuriance of one or more of these grasses. Hence proceeds the constant supply of succulent herbage throughout the season ; a circumstance which but seldom happens in artificial pastures, where the herbage consists of two or three plants only. If the best natural pastures be examined during various periods of the

season, the whole, or a part of the following plants will be found in the turf.

Spring and Summer Produce.

Meadow fox-tail, round cock's-foot, meadow fescue, meadow cat's-tail, sweet-scented vernal, tall oat-like soft grass, creeping vetch, ray-grass, field brome grass, annual meadow-grass, and meadow oat-grass.

Summer and Autumn Pasturage.

Yellow oat-grass, meadow barley, crested dog's-tail, hard fescue, rough-stalked meadow grass, smooth-stalked ditto, woolly soft grass, cow clover, Dutch clover, yellow vetch, and smooth fescue.

Autumn Pasturage.

Creeping bent or fiorin, marsh bent grass, and creeping couch grass.

Besides these, there are other plants invariably found in the richest natural pastures, as *ranunculus acris* (butter cups), *achillea millefolium* (milfoil, or yarrow), *plantago lanceolata* (rib grass, or ribwort plantain), and *rumex acetosa* (sorrel-dock). But of these, the rib-grass and butter-cups were by far the most common, the yarrow and sorrel-dock being confined to particular spots. I have been, says the author, in the practice for many years of examining these pastures at various periods of the season, but I never noticed any indication of the cattle (horses, cows, and sheep) having touched the butter-cups or the sorrel.

We have already given a general list of the grasses, and a few other pasture plants; we now come to the details of the author's experiments for ascertaining their comparative value, as shown by his chemical tests, together with the conclusions he has come to, as to their real worth to the farmer and grazier.

ANTHOXANTHUM odoratum. Sweet-scented vernal grass.

Specific character : spike egg-oblong shaped ; florets longer than the awns, and supported on short foot-stalks.

Obs.—Blossom double, the outer one entirely different from that of any other grass, its outside covered nearly to the top with stiff brown hairs lying flat ; stem thinly haired, and shining joints. Native of Britain.

Experiments.—The produce of herbage from a space of four square feet, soil a brown sandy loam with manure, on the 1st of April, yielded

by weight per acre.....	3,488 lbs.
At the time of flowering	7,827
At the time the seed is ripe	6,125
The produce of after-math	6,806

The proportional value which the grass of the latter-math bears to that of the seed crop, is nearly as 13 to 9 ; and the proportional nourishment contained in the autumn grass, exceeds that of the first grass of the spring as 9 to 7.

This grass constitutes a part of the herbage of pastures on almost every kind of soil, though it only attains to perfection in those which are deep and moist. The chief property is its early growth, though in this respect it is inferior to several other species which are later in flowering. It thrives best when combined with many different species, and therefore is a true permanent pasture grass. It does not appear to be particularly liked by cattle, though eaten in pastures in common with others. Mr. Grant, of Leighton, laid down a field of considerable extent, one half of which was sown with this grass and white clover, the other half with meadow fox tail and red clover. The sheep would not touch the sweet-scented vernal and white clover, but kept constantly on the fox tail grass, though the dwarfish nature of the sweet vernal had occasioned an unusual degree of luxuriance of the white clover with which it was combined. This would indicate that it is not, when single, or when combined with two or three different species, very grateful to cattle. The



Anthoxanthum

Odoratum.



Dactylis

glomerata

chemical examination of its nutritive matter shows that it does not abound in sugar, but chiefly in mucilage; and the insoluble extract is in a greater proportion than in many other grasses. Its merits, however, in respect to early growth, continuing to vegetate and throw up flowering stalks till the end of autumn, and its hardy nature, sufficiently uphold its claim to a place in all permanent pastures. The superior nutritive quality of its latter-math is a great recommendation for the purpose of grazing, the stalks being of but little utility, as they are generally left untouched by the cattle, provided there be a sufficiency of succulent herbage.

It is said to give to new-mown hay that delightful scent which is peculiar to it: if it be not the sole cause of the fragrance, it certainly adds considerably to its sweetness. About the middle of April it comes into flower, and the seed is ripe about the first or second week of June.

DACTYLIS glomerata. Round paniced Cock's-foot grass.

Specific character: panicle crowded, pointing one way; leaves keeled; native of Britain.

Experiments.—The produce of herbage from a space of four square feet of a rich sandy loam, on the 15th April, is per acre, in weight (calculated proportionally), 10,209 lbs. Produce at time of flowering 27,905 lbs.; at time the seed is ripe, 26,544 lbs. The proportional value at the time the seed is ripe, to that at the time of flowering, is as seven to five. The produce of after-math is 11,910 lbs.

By various other tests to which the leaves and stems were submitted at different periods of their growth, the author found that the stems, when full grown, contain more nutriment than the leaves at any time; and his general conclusions respecting this grass are, that it is more valuable for pasture than for hay, and for the latter purpose is superior to ray grass, and many others. If constantly kept closely grazed, it yields a greater profit than used in any other way, merely because the leaves grow rapidly and give a full bite.

Oxen, horses, and sheep eat this grass readily. For the superiority of this over ray grass, proved by an extensive cultivation of it, the agricultural world is indebted to the Earl of Leicester, who first persevered in the culture of it at Holkham. The seed was first brought into market by Messrs. Gibbs, seedsmen, Half-Moon Street, Piccadilly, and who have continued to cultivate this and every other sort of grass recommended to farmers by the author of this work.

ALOPECURUS pratensis. Meadow Fox-tail grass.

Specific character: flowers in a spike; straw upright; calyx hairy; blossom awned. Native of Europe.

Experiments.—A similar quantity of the herbage of this species, cut on the 12th April, yielded 9,528 lbs. per acre; and at the time of flowering 20,418 lbs. from off a clayey loam. The produce from a sandy loam was 8,507 lbs. The after-math from the clayey loam weighed 8,167 lbs. The proportional value of the grass of the latter-math to that at the time of flowering, is as twenty-four to thirteen; and the crop, at the time the seed is ripe, is to that of the latter-math as three to two.

This grass, under the best management, does not attain to its full perfection till it is four years from the seed: hence it is inferior to the cock's-foot for the purpose of alternate cropping. The herbage, however, contains more nutritive matter than that of the cock's-foot, though the weight of grass produced in one season is considerably less. It thrives well under irrigation, keeping possession of the crowns of the ridges: it is strictly permanent. Sheep are very fond of it: when combined with white clover only, the second season, on a sandy loam, it is sufficient for the support of five couples of ewes and lambs per acre. As it only thrives on moderately moist land, and being longer in arriving at full productiveness, its merits have been misunderstood in many instances; and in others, as in the alternate husbandry, it has been by some persons set aside altogether.



Alopecurus

pratensis.



pancis.

It is the principal grass in all rich natural pastures; and therefore, in laying down permanent pastures, it should always form *one-eighth* of any mixture of seeds used for that purpose. Its merits demand this preference, whether with respect to early growth, produce, nutritive qualities, or permanency. Birds are fond of the seeds, and therefore the seeds should be collected from the first culms that ripen. It flowers in April, May, and June, according as it may have been depastured earlier or later. Seed ripens in June and July, according to the season of flowering.

POA pratensis. Smooth-stalked Meadow grass.

Specific character: panicle spreading; spikelets five-flowered, smooth; straw erect, round; root creeping, perennial. Native of Britain.

Obs.—This grass is distinguished from the *poa trivialis*, rough-stalked meadow grass, by its strong creeping roots, and the sheaths of the straw being smooth; whereas in the *poa trivialis* the sheaths are rough to the touch; the sheath scale is blunt, in the other it is pointed, and so are the leaves.

Experiments.—At the time of flowering, the produce from a clayey loam, rich with vegetable matter, of active peat, is 10,209 lbs. per acre; when the seed is ripe, 8,507 lbs.; and the latter-math weighed 4,083 lbs.

This species sends forth its stems but once in the year; and these being the most valuable for hay, though too small in quantity, it is on this account better adapted for pasturage than for the scythe. But upon the whole it is an inferior grass; its strong creeping roots exhaust the soil; its growth after mowing is slow; and its spring growth, though early, is inconsiderable; and, upon the whole, it is unfit to be introduced among the superior sorts. It flowers in the beginning of June, and ripens seed in the beginning of July.

POA carulea. Short Blue Meadow grass.

Specific character: panicle diffuse; spikelets oval, gene-

rally three-flowered ; husks acute, connected by a villus ; sheath-scale very short, obtuse.

Obs.—This grass is allied to the *poa pratensis*, but may be distinguished therefrom by its delicate sky-blue or glaucous colour. The root is powerfully creeping. Native of Britain*.

Experiments.—At the time of flowering, the produce from a clayey loam enriched with bog earth is 7,486 lbs. per acre.

The produce of latter-math is 4,084 lbs. per acre.

This grass is common in meadows where the soil is peaty ; it generally inhabits the drier parts. It is eaten by horses, oxen, and sheep, indifferently with other grasses ; hares, however, prefer the *poa pratensis* to this : for five successive years they cropped a patch of the *poa pratensis*, and left untouched a similar space of this grass that grew close by it. The proportion of saccharine matter was greater, in the nutritive matter of the *poa pratensis*, compared to that of the other constituents, mucilage and bitter extractive, than in the nutritive matter of this species of *poa*, which contained more bitter extractive. This seems to confirm, with respect to the liking of the hare, what Sir Humphry Davy has proved with respect to the grasses most liked by cattle, “that they have either a saline or subacid taste.”

On a rich warm springy gravel, shaded with shrubs, Mr. Taunton found this grass rising to the height of three feet in the culm, and having an exceedingly handsome appearance, from fine luxuriant foliage ; but on a stiff clay he never found it exceed ten inches in height.

What was before said of the demerits of the *poa pratensis* likewise applies to this grass ; and, from the above facts, it is evidently one of the inferior pasture grasses, and cannot be recommended for cultivation with any prospect of advantage, unless in particularly dry soils, where supe-

* In the following digest of the work, all the authorities and references to other works are left out, as well as all botanical criticism, fractions of quantities, in short, all redundant matter of which no use could now be made.—ED.



Poa Trivialis

rior grasses do not thrive. Flowers in the beginning of June, and ripens the seed in the beginning of July.

POA trivialis. Rough-stalked Meadow-grass.

Specific character: panicle rather spreading; spikelets three-flowered; florets lanceolate, five-ribbed, connected by a web; stipula oblong; stem and leaves roughish; root fibrous.

Obs. The great roughness of the culms and leaves manifested when drawn between the fingers, the sharp-pointed sheath-scale, and the fibrous root, so conspicuous in this species, sufficiently distinguish it from the *poa pratensis*. Native of Britain; root perennial.

Experiments.—At the time of flowering, the produce from a brown loam with manure is 7,486 lbs. per acre.

The produce of the latter-math is 4,764 lbs. per acre.

The proportional value in which the grasses of the latter-math exceeds that of the flowering crop, is as 3 to 2, and that of the seed crop as 12 to 11.

Here then is a satisfactory proof of the superior value of the crop at the time the seed is ripe, and of the consequent loss sustained by taking it when in flower; because, in this instance, the weight of each crop is nearly the same, and the latter-math, which would be produced in the time that is taken up in perfecting the seed, is infinitely less than that of many other species of grass, where the loss of latter-math, under such circumstances, would far outweigh any superiority of the nutritive qualities of the crop at the time the seed is ripe, if such superiority was great, which is seldom found.

The weight of hay produced from grass of the flowering crop is much less than that which is produced by an equal weight of the grass of the seed crop. In Mr. Young's *Annals of Agriculture* we are informed, that so long ago as the year 1785, Mr. Boys, of Betshanger in Kent, a farmer of the highest reputation, raised, at much expense, and several years' attention, from twenty to thirty bushels of the seed of this grass, which he then offered for sale at

three shillings per pound. He says that it makes a very fine thick turf, and will produce a great quantity of very excellent grass from moist rich soils. He used the straw after the seed was thrashed, instead of hay, for his riding-horses, and they preferred it to his best meadow hay. To have the land covered thick, more than seven pounds of seed should be sown to the acre. Dr. Smith observes, that it does not bear the frost so well, nor does it shoot so early in the spring, as the *poa pratensis*; but when the weather becomes warm enough to make grasses in general shoot, this grows faster, and produces a greater crop of bottom leaves than most others. The experiments above detailed were made before I met with the observations of Mr. Young and Dr. Smith, just quoted, and all my observations tend to confirm those opinions concerning this grass, except as regards its fitness to form a pasture of itself, stated by Mr. Boys.

The superior produce of this *poa* over many other species, its highly nutritive qualities, the seasons in which it arrives at perfection, and the marked partiality which oxen, horses, and sheep have for it, are merits which distinguish it as one of the most valuable of those grasses, which affect moist rich soils and sheltered situations: but on dry exposed situations it is altogether inconsiderable; it yearly diminishes, and ultimately dies off, not unfrequently in the space of four or five years. Its produce is always much greater when combined with other grasses than when cultivated by itself: with a proper admixture it will nearly double its produce, though on the same soil, so much it delights in shelter. Those spots in pastures that are most closely eaten down, consist for the most part of this grass: I have examined many pastures with this view, and always found it the case wherever this grass was more predominant. From all which it appears, that the *poa trivialis*, though highly valuable as a permanent pasture grass on rich and sheltered soils, is but little adapted for the alternate husbandry, and unprofitable for any purpose on dry exposed situations. It flowers towards the end of June, and ripens the seed in the middle of July.



Festuca Pratensis.

FESTUCA *pratensis*. Meadow Fescue.

Specific character : Panicle nearly upright, branched, spreading, turned to one side ; spikelets linear, compressed ; florets numerous, cylindrical, obscurely ribbed ; nectary four-cleft ; root fibrous.

Refer.—*Fig.* 1. Spikelet magnified, showing florets and the calyx. 2. Four-cleft nectary. 3. Obvate germen, with its short styles and thick feathery stigmas.

Native of Britain. Root fibrous, perennial.

Obs.—Dr. Withering makes this a variety of the *festuca elatior* ; but it is more justly made a distinct species in Sir J. E. Smith's English Botany, and in his English Flora. It differs from the *festuca elatior* in being only half the height, the leaves only half the breadth, the panicle shorter, and containing only half the number of flowers. The panicle is but once branched, droops but slightly, and leans to one side when in flower, and the flowers grow all one way. In the *elatior* the panicle branches both ways, it droops much at first, and the flowers grow much more loosely ; the spikelets are more round, ovate, and pointed : whereas in the *pratensis* they are somewhat linear, flat, and obtuse.

Experiments.—On the 16th of April, the produce from a fertile peat soil, with coal ashes as manure, is 10,890 lbs. per acre.

The grass at the time of flowering is of greater value than at the time the seed is ripe, proportionally as 3 to 1.

The weight of nutritive matter which is lost by leaving the crop of this grass till the seed be ripe, is therefore very great. That it should lose more of its weight at this stage of growth than at the time of flowering, perfectly agrees with the deficiency of nutritive matter in the seed crop, in proportion to the nutritive matter afforded by the flowering crop ; the straws being succulent in the grass of the latter crop, while those of the former are dry, and constitute a much smaller proportion of the weight of the crop than in the flowering crop. It may be observed here, that there is a great difference between culms and leaves of grasses that have been dried after they were cut in a green and succulent

state, or in possession of their nutrient qualities, and those culms and leaves which have been dried (if I may so express it) by Nature when growing: the former retain all their nutritive powers, but the latter very little, if any. In point of early produce in the spring, this grass stands next to the *alopecurus pratensis* (meadow fox-tail), and is superior in this respect to the cock's-foot.

It is eaten by horses, oxen, and sheep, but particularly by the two first: its merits will be more clearly seen by comparing it farther with the cock's-foot and meadow fox-tail. As it is often three weeks later in flowering than the fox-tail grass, the latter-math produce must be left out for the truth of comparison, as regards its comparative value for hay; and as it is much slower in growth after being cropped than the cock's-foot, it is likewise necessary to omit the latter-math in a comparison of their produce.

The meadow fescue constitutes a very considerable portion of the herbage of all rich natural pastures and irrigated meadows; it makes excellent hay, and though a large plant, the leaves or herbage are succulent and tender, and apparently much liked by cattle, as they never form rank tufts, which is the case with the larger grasses. It does not appear to arrive at its full productive powers from seed so soon as either the cock's-foot or fox-tail grass, and though essential for permanent pasture, is not by itself very well adapted for the alternate husbandry, but should be combined with cock's-foot, ray-grass, and rough-stalked meadow-grass. Mr. Taunton's experience of this grass on a stiff clayey soil proved, that a copious crop of seed-stalks may be obtained the second year from sowing. Flowers in June, and ripens the seed at the end of July and the beginning of August. In the deep alluvial soils in Lincolnshire, this grass is not so prevalent as in the clay districts. In the vale of Aylesbury it constitutes a considerable portion of the most valuable and fattening pastures of that rich grazing district.

CYNOSURUS *cristatus*. Crested Dog's-tail grass.

Specific character: Spike simple, linear; neuter spikelets without awns. *Fig. 1.* Spikelets, showing the floral



Cynosurus

Cristatus.

leaves and neuter florets. 2. Ditto, mag. 3. Floret, 4. Germen, valves, or nectary.

Obs.—Floral leaves deeply divided into awl-shaped segments. Husks generally containing three flowers. Smaller valve of the blossom ending in two points: larger valve ending in a short awn. Florets all facing one way. This grass is often viviparous; in wet seasons I have found it generally so, in Woburn Park under the trees. I have found the *alopecurus pratensis* under the like circumstances viviparous. Root perennial. Native of Britain.

Experiments.—At the time of flowering, the produce from a brown loam, with manure, is 6125 lbs. per acre.

The produce of latter-math is 3,403 lbs. per acre.

The proportion in which the grass at the time of flowering exceeds that at the time the seed is ripe, with respect to nutritive powers, is as 17 to 10, and is superior to the latter-math in the like proportion.

The quantity of grass at the time the seed is ripe, is just twice as much as at the time of flowering; but the grass at the former period contains nearly twice the quantity of nutritive matter, as appears above; and when the latter-math, which would be produced during the time the seed was ripening, is added to this, it shows the superior advantage of taking the crop when the grass is in flower. The culms of this grass are of a wiry nature, and, at the time the seed is ripe, contain no nutritive matter. The leaves are rather slow in growth, are short, but form a dense turf; hence, the weight of grass at the time the seed is ripe is greater than at the time of flowering, but contains proportionally less nutritive matter. It is therefore inferior for the purpose of hay, but admirably adapted for permanent pasture. The roots penetrate to a considerable depth in the ground, from which circumstance it continues green after most other grasses are hurt by a continuance of dry weather. Mr. Curtis observes, that it affects a dry soil, and that it will not thrive in meadows that are wet; but I have always found it more abundant in moist, or rather tenacious elevated soils, than in those of a drier and more sandy nature. In irrigated mea-

dows it thrives in perfection, attaining to a greater size than in any other situation. In some parts of Woburn Park, this grass constitutes the principal part of the herbage, on which the deer and South Down sheep chiefly browse, while another part of the Park, which consists chiefly of the *agrostis vulgaris fascicularis*, *agrostis vulgaris tenuifolia*, *festuca ovina*, *festuca duriuscula*, and *festuca Cambrica*, is seldom touched by them; but the Welsh breed of sheep almost constantly browse on these, and almost entirely neglect the *cynosurus cristatus*, *lolium perenne*, and *poa trivialis*. There has been a difference of opinion with respect to the merits of this grass: it certainly does not afford so early a bite to cattle in the spring as many other grasses, and the culms are uniformly left untouched: but this is more owing to the season in which they are produced, than to any particular defect; as there is then a profusion of root leaves and herbage in general, which is always preferred by cattle to the culms: when the grass is in flower, the culms are succulent, and contain much nutritive matter; it is all, however, exhausted in perfecting the seed. If this grass is employed only for the alternate husbandry, and its merits from thence estimated, it will be considered an inferior grass, as it is by no means adapted for that purpose, either with respect to speedily arriving at perfection, early growth, or quantity of produce; but it forms a close dense turf of grateful nutritive herbage, and is little affected by the extremes of weather, where other grasses, superior in the fore-mentioned points, would be produced in tufts, and injured by the extremes of weather. From these facts it is evident, a sward of the best quality, particularly under circumstances where sheep are a principal object, cannot be formed without an admixture or proportion of the crested dog's tail grass. In all the most celebrated pastures I have examined, it constituted a very considerable portion of the produce. It flowers towards the end of June, and ripens the seed towards the end of July. The culms are valuable for the manufacture of straw bonnets*.

* In the opinion of those who have the care of high-bred horses, the best hay to be met with in the London markets is the *upland mea-*



Festuca

duriuscula.

FESTUCA *duriuscula*. Hard Fescue.

Specific character: Panicle unilateral, spreading; florets longer than their awns; stem round, upper leaves flat, root fibrous. *Fig.* 1. Calyx, with unequal valves. 2. Floret, or corolla and anthers. 3. Germen, or rudiment of the future seed, and the feathered cylindrical stigmas.

Obs.—Sir James Edward Smith, in his English Botany, observes, “that in this genus it is hard to say what may, or what may not be a species;” and, with his usual force and clearness, he reduces the *festuca glauca*, *festuca glabra*, *festuca Cambrica*, *festuca duriuscula*, and *festuca rubra*, of Hudson, Lightfoot, Withering, Winch, and Stillingfleet, &c. into one species. All these grasses vary much from change of soil and situation; the flowers are particularly apt to vary in number, as well as in the length of their awns: there is one character, however, which I have never found to change under any variety of culture, which is the creeping root; and this is also an agricultural character of distinction which is never to be lost sight of, as it always produces a *specific* effect upon the soil, very distinct indeed from that of the fibrous-rooted kinds. The botanical characters given by the learned, being, therefore, insufficient to distinguish these grasses (which I have no doubt will be equally so with many of the present specific distinctions of plants, when discoveries have been sufficiently extended over every country), I will here consider them of two distinct species—the creeping-rooted, and the fibrous-rooted: noting their varieties from other parts of the plant. This will be sufficient for the purposes of the agriculturist; or, at least, to practical men the discriminating characters will be

dow hay, from the neighbourhood of Hendon. The crop is usually cut early in June, and consists chiefly of the *cynosurus cristatus*; hence this species is called, *par excellence*, the Hendon bent.—

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much less embarrassing, and obviate, in a great measure, in these plants the danger of mistake.

Root fibrous. Perennial.

Experiments. — At the time of flowering, the produce from a clayey loam with manure, is 18,376 lbs. per acre.

The produce of latter-math is 10,209 lbs.

The proportional value in which the grass, at the time of flowering, exceeds that of the latter-math, is as 14 to 5; and to that at the time the seed is ripe, as 6 to 5.

The above details confirm the favourable opinion which most writers have expressed respecting this grass. It is most prevalent on light rich soils; but it is likewise always found in the richest natural pastures, where the soil is more retentive of moisture, and is never absent from irrigated meadows that have been properly formed. It appears to be one of the best of the fine, or dwarf-growing grasses; which are best adapted for the food of sheep, as the *festuca ovina*, *festuca rubra*, *poa pratensis*, *agrostis vulgaris*, &c. Hares are fond of this grass, they cropped it close to the roots, and entirely neglected the *festuca rubra* and *festuca ovina*, which grew contiguous to it. It attains to the greatest perfection when combined with the *festuca pratensis* and *poa trivialis*. It springs rather early, and the produce is remarkably fine and succulent. It withstands the effects of severe dry weather in rich natural pastures better than many other grasses. This property, joined to its merits above-mentioned, entitle it to a place in the composition of the best pastures, though in a smaller proportion, on account of its inferior productive powers, which are not compensated by any superiority in the nutritive qualities of the grass over those grasses that are more productive, as is the case with the *poa trivialis*, and some other species.

The superiority of these natural pastures over those pastures which are formed of one or two grasses only, in respect of a constant or never-failing supply of herbage throughout the season, is in one point, among many others, owing to the variety of habits which exist in a numerous assemblage of different grasses. Some species thrive best in an excess of moist weather; others in a continuance of dry weather;



Festuca

cambrica.

but the majority of the grasses which compose the produce of the pastures in question, thrive best in a middle state between moisture and dryness. Observation will furnish abundant proofs of the truth of this, by comparing the different states of productiveness in natural pastures, during a season of changeable weather, with those of artificial pastures under the like influence of soil and climate. It flowers about the middle of June, and ripens the seed in the third week of July. When cultivated on a poor siliceous soil, or on a thin heath soil, the culms become very fine and slender, and promise to be valuable for the manufacture of straw hats.

FESTUCA *Cambrica*. Welsh Fescue.

Specific character: Panicle compact, oblong, upright, branched, spikelets awl-shaped, awned, leaves flat.—

Fig. 1. Spikelet magnified. *2.* Floret magnified, showing the spreading-feathered stigmas.

Obs.—This CONSTANT variety of *festuca rubra* is distinguished at first sight from the *festuca ovina*, and varieties of *festuca rubra*, and *festuca duriuscula*, by the pale green colour of the panicle and culm. The root leaves grow more upright and flat; when cultivated, the spikelets consist of ten or twelve florets. Stipulæ membranous, blunt.

Root creeping. Perennial.

Experiments.—At the time of flowering, the produce from a sandy soil is 6,806 lbs. per acre.

The value of the grass at each stage of growth is equal. The superior weight of nutritive matter afforded by the crop at the time the seed is ripe, arises from the increase of grass which takes place during the time the seed is perfecting; and in this case, as in all others where it is shown that the nutritive matter of the seed crop exceeds that contained in the flowering crop, the loss of latter-math which would have been produced in the time the seed was perfecting must always be considered: this caution is perhaps unnecessary to the truly practical farmer. When the practice becomes general of saving the necessary quantity of seed for the farm,

(which I doubt not will happen, though at a remote period), these comparisons between the value of the flowering and seed crops will possess their proper interest. The seed crops of the natural grasses are in general, at least as far as my observations have reached, left too long growing; the green, or the withered state of the culms, is an uncertain criterion to judge of the ripeness of the seed of the *perennial* grasses, though generally good for the different *annual* sorts. In the greater part of the perennial grasses, the culms are far from being either withered or dry when the seed is ripe, which is determined, in almost all cases, by passing the spike or panicle between the fingers; if a portion of the seed separate by this means, it will be found in the best state for collecting; it should, however, be suffered to remain in the ears after being cut until the grass be perfectly dry. When the grass is suffered to remain uncut till the culms are withered and dry, and the seed separates on a slight touch, the grass is rendered of little value, and the seed not improved in quality: the best part of the seed is either lost by devouring birds or insects, or shaken out in the process of cutting and collecting. I have made a number of experiments on the seeds of grasses and other plants, by sowing at different degrees of what is termed ripeness, and the results went always to prove the truth of the above remarks; also that diseased or imperfectly-formed seed always vegetated best when sown directly after being separated from the plant. An ounce of this seed vegetated by this treatment in three different trials; the same seed, kept dry for two months only, did not vegetate by the like means employed in sowing, or any other that I attempted. I have repeated experiments of this nature with much interest and care, but the principle still remained unaltered.

The produce of latter-math is 6,125 lbs. per acre.

From the above results it appears, that this grass is much inferior to the *festuca duriuscula* in the quantity of its produce, as well as in nutrient qualities; which will be evident on a comparison of these properties, as mentioned in the foregoing details. It springs rather earlier than the hard fescue, and also rises better after being cropped, but not, apparently,

in a sufficient degree to compensate for its deficiencies in other respects. It is far from being so common as the *f. duriuscula*, and inhabits the drier spots of pastures. Flowers some days earlier than the *f. duriuscula*, and ripens the seed about the same period as that grass.

FESTUCA ovina hordeiformis. Long-awned Sheep's Fescue.

Specific character : Panicle compact, branches subdivided, upright. Spikelets crowded, six to ten flowered. Root leaves thread-shaped, stem leaves very long.

Obs.—In the first account of the results of these experiments, this grass is received under the name of *festuca hordeiformis*. Though there are names received among botanists not less incongruous than this one, yet I am happy to agree with the opinion of Mr. Sowerby in considering it a variety of the *festuca ovina*. I am uncertain as to its native place of growth, having never discovered it in any soil or situation in a wild state. The culms are strongly marked with ribs.

Root fibrous, perennial. Native of Britain?

Experiments.—At the time of flowering, the produce from a sandy soil with manure is 13,612 lbs. per acre.

The produce of latter-math is 5,445 lbs. per acre.

The proportional value in which the grass at the time of flowering exceeds that at the time the seed is ripe, is as 9 to 7 : and it exceeds the value of the latter-math grass in the like proportion. The grass of the seed crop and that of the latter-math are equal in the quantity of nutritive matter they contain, a circumstance easily accounted for, as the culms at the time the seed is ripe are drier than in most other grasses at the same stage of growth ; and the produce then consists almost entirely of leaves, similar to the latter-math produce. This species flowers earlier than any other of the fescue species. Its nutritive qualities are nearly the same as those of the *festuca duriuscula*. It is superior to that species and to most others in the produce of early herbage in the spring ; the herbage is very fine, tender, and succulent. It is highly superior to the *festuca ovina*, of which

it is considered a variety. It does appear to possess merit in a sufficient degree to entitle it to a place in the composition of the best pastures, particularly as a substitute for the *festuca duriuscula*, which might be effected with advantage on soils of a drier or sandy nature. It flowers in the last week of May, and ripens the seed in June. The culms are well adapted for the manufacture of the finest straw-plait, being very distant in the joints, and of an equal thickness throughout. By the compression of the straws, in the process of plaiting, the furrows of the culms disappear entirely.

AVENA flavescens. Golden Oat, Yellow Oat-grass.

Specific character: Panicle much branched, spreading, erect; calyx three-flowered, short, all the florets awned.

Fig. 1. Calyx with its unequal valves. 3. The same magnified. 2. Floret, with the awn arising from above the middle of the outer valve. 4. The same magnified. 5. Germen obovate, stigmas densely feathery. 6. Styles short, distinct.

Root fibrous, perennial. Native of Britain.

Experiments.—At the time of flowering, the produce from a clayey loam is 8,167 lbs. per acre.

The produce of latter-math is 4,083 lbs. per acre.

The proportional value in which the grass, at the time of flowering, exceeds that of the latter-math, is as 3 to 1; and the grass, at the time the seed is ripe, is to that of the latter-math as 9 to 5.

This is one of those grasses which never thrives when cultivated simply by itself; it requires to be combined with other grasses to secure its continuance in the soil, and to obtain its produce in perfection. It thrives best when combined with the *hordeum pratense* (meadow barley), *cynosurus cristatus* (crested dog's-tail), and *anthoxanthum odoratum* (sweet-scented vernal-grass). It affects most a calcareous soil, and that which is dry. It grows naturally, however, in almost every kind of soil, from the lime-stone rock to the irrigated meadow: it is always present in the richest natural



Avena Flavescens.

pastures. From the above details, its produce is not very great, nor its nutritive qualities considerable. The nutritive matter it affords from its leaves (the properties of which are of more importance to be known than those of the culms, for a permanent pasture grass), contains proportionally more bitter extractive than what is contained in the nutritive matters of the grasses with which it is more generally combined in natural pastures, and which have just now been mentioned. This latter circumstance is the chief claim it has to a place in the composition of the produce of rich pasture land ; but more particularly, if the land be elevated and without good shelter, this grass becomes more valuable, as it thrives better under such circumstances than most other grasses, and sheep eat it as readily as they do most others. The seed is very small and light ; but it vegetates freely if sown in the autumn, or not too early in the spring. I have sown the seeds of this grass in almost every month of the year ; and, after making due allowance for the state of the weather, the third week in May, and the first week of August to September, were evidently the best.

It flowers in the first and often in the second week of July, and ripens the seed in the beginning of August.

HOLCUS *lanatus*. Woolly Soft-grass.

Specific character : Root fibrous ; calyx woolly ; lower floret perfect, awnless, upper with an arched awn ; leaves downy on both sides.

Fig. 1. Calyx magnified, showing the dotted, hoary valves, the innermost broadest. 2. The two florets, shorter than the calyx. 3. Germen and slender-feathered stigmas.

Obs.—Practical farmers often mistake this grass for the creeping-rooted soft-grass ; I have therefore given a figure of the latter in the next following page, for the convenience of comparison, otherwise it belongs to another division of the subject, that is, grasses natural to sandy soils. The male, or unisexual floret, contains one pistil ; the germen, or rudiment of the future seed,

is similar to that of the fertile or bisexual floret, but much smaller; it is always abortive. Seed with a shining hardened coat, which was formerly the corolla.

Native of Britain. Perennial.

Experiments.—About the middle of April the produce from a clayey loam is 4,764 lbs. per acre.

The proportional value in which the first grass of the spring is inferior to that at the time of flowering, is as 16 to 9; and the grass of the flowering crop exceeds that of the seed crop in the proportion of 16 to 11.

The produce of latter-math is 6,806 lbs. per acre.

The grass of the latter-math is therefore of inferior value to that of the spring, to that at the time of flowering, and to that at the time the seed is ripe.

This is a very common grass, and grows on all soils, from the richest to the poorest. It attains to the greatest degree of luxuriance on light moist soils; particularly on those of a peaty nature. Cattle prefer almost any other grass to this; it is seen in pastures with full-grown perfect leaves, while the grasses that surround it are cropped to the roots.

The numerous downy hairs which cover the surface of the whole plant render the hay that is made of it soft and spongy, and in this state it is disliked by cattle, particularly by horses. Sir Humphry Davy has shown that its nutritive matter consists entirely of mucilage and sugar; and that the nutritive matters of the grasses most liked by cattle have either a sub-acid or saline taste; and observes, that the taste of the nutritive matter of the *holcus lanatus* is similar to that of gum Arabic; and this grass might probably be made more palatable to cattle by being sprinkled over with salt. This may be done at so little expense and trouble at the time the hay is carried, that it cannot be too earnestly recommended to the notice of those gentlemen who may have much of this grass in their meadows or pastures. The late Duke of Bedford made trial of this grass on a large scale: the results proved that it was a very inferior grass for pasture or for hay. Its merits consist in being productive and easy of cultivation. But it is disliked by cattle, is not an early grass, and when once in possession of the



Holcus Lanatus.

Holcus Mollis.

soil can hardly be again rooted out. There being so many grasses superior to this in every respect, it cannot support a good claim to a place in the composition of the best permanent pastures, and for cultivation singly, or by itself, it is wholly inadmissible. The quantity of nutritive matter it affords, and being found a constituent of the produce of some of the richest grazing lands in Devonshire, are circumstances, however, which recommend it to a place, in a small degree, in permanent pastures, where the soil is not light and siliceous; where the soil is light and siliceous it will increase to a degree injurious to the superior grasses of the pasture. The seeds of the *holcus lanatus* should therefore not be introduced under the circumstances of soil above mentioned without much caution. It produces a profusion of seed, which, being light, is easily dispersed by the winds; and though a late-flowering grass, the seed ripens sooner than that of most others, and before hay harvest begins is generally perfected. The question is, therefore, how to get free of it: hard stocking, and never suffering it to run to seed, will at least prevent it from spreading farther. But ploughing up the pasture, and taking not less than a five years' course of crops, and then returning the land to other grasses, will be found the best remedy. Flowers and ripens the seed in July.

HOLCUS *mollis*. Creeping Soft-grass.

Specific character: Root-creeping; calyx partly naked; lower floret perfect, awnless, upper with a sharply-bent prominent awn; leaves slightly downy.

Fig. above, the two florets; the lower one perfect, awnless, the upper showing the recurved awn: which is a certain mark of distinction between this and the *holcus lanatus*. *Fig.* below, Calyx magnified. Right hand *Fig.*, Germen and feathered stigma.

Obs.—The creeping root of this species of soft grass at once determines it to be distinct from the *holcus lanatus*. The leaves are also narrower, and more soft than those of the *holcus lanatus*, and grow more distinct from each

other; on the contrary, those of the *h. lanatus* are in dense tufts. The awn in the *lanatus* is hid in the calyx; but in the *mollis* it protrudes out of the calyx; it is also twisted and knee-bent, like that of an *avena*. The panicle of the *lanatus* is generally of a reddish purple colour, tinged with green, or, when growing under the shade of trees, of a whitish green colour. The panicle of the *h. mollis* is always of a pale whitish green colour.

Perennial. Native of Britain.

Experiments.—At the time of flowering, the produce from a sandy soil is 34,031 lbs. per acre.

The proportional value in which the grass of the flowering crop exceeds that of the seed crop, is as 9 to 7.

The above details prove this grass to have merits which, when compared with those of other species, rank it as one of the superior grasses; but then it produces little herbage in the spring, and the latter-math is next to nothing. It is also a very late grass, and whatever merit it may possess with regard to a crop, at the time of flowering, it can only be taken into the account in relation to the soil which naturally produces it, which is a light barren sandy soil. If we therefore compare its produce on such soils with that of other grasses, it will prove superior; but there it must remain, for on all other soils it will be found inferior to most other grasses. The roots, when once in possession of the soil, can hardly be again expelled without great labour and expense. It is the true couch-grass of light sandy soils. I have found roots five feet in length, the growth of a few months only. The roots contain a very considerable quantity of nutritive matter, which has the flavour of new-made meal. Pigs are very fond of the roots, and dig them up with eagerness. How far it might be advantageous to cultivate this grass on naked sands, for the sake of the roots, I shall not presume to determine: but the strong nutritive powers they possess, and the little expense that would attend their culture, warrant the recommendation of trial to those who may have such barren sands in their possession. The herbage is apparently more disliked by cattle

than that of the *holcus lanatus*; it is extremely soft, dry, and tasteless. The best mode of banishing this impoverishing and most troublesome weed from light arable lands that are infested with it, is to collect the roots with the fork after the plough; and when thus in some measure lessened, to apply yearly sufficient dressings of clay, perhaps fifty loads per acre, till the texture of the soil is changed to a sandy loam: this grass will then be easily overcome, and the fertility of the soil permanently increased.

HOLCUS odoratus (repens). Sweet-scented Soft-grass, or Northern Holy-grass.

Specific character: Panicle somewhat unilateral; fruit-stalks smooth; perfect floret awnless; barren ones slightly awned.

Obs.—Botanists have made two species here, which I include in one, as I can perceive no difference in their structure, habits, or agricultural merits, sufficient to separate them. The *nectary* is the only part wherein these plants vary from each other in a sensible degree, but what may be accounted for from the circumstances of soil and situation. If they are to remain distinct species, they are artificial in no ordinary degree. Since the above remarks were first published, that important work, the English Flora, has been given to the public: from which it appears that this grass has been found a native of valleys among the Highlands of Scotland, and I willingly submit to the opinion of the author, in considering this species distinct from the *holcus Australis*.

Root creeping. Perennial. Native of valleys among the Highlands of Scotland; and in Germany grows in moist meadows.

Experiments.—At the time of flowering, the produce is 9,528 lbs. per acre.

The produce of latter-math is 17,015 lbs. per acre.

The proportional value in which the grass of the seed crop exceeds that at the time of flowering, is as 21 to 17. The

grass of the latter-math, and the grass at the time of flowering, are of equal proportional value.

Though this is one of the earliest flowering grasses, it is tender, and the spring produce of herbage is very inconsiderable, the flowering straws rising up in a manner destitute of leaves. This deficiency of produce is much to be regretted, as the nutritive qualities of the grass are greater than in most of the early spring grasses: it sends forth but a few flower straws, which are of a slender structure, compared to the size of the leaves. This accounts, in a great measure, for the equal quantities of nutritive matter afforded by the grass at the time of flowering, and that of the latter-math. The grasses which flower about the same time as this species are—blue moor-grass (*sesleria caerulea*), Alpine meadow-grass (*poa Alpina*), and the sweet-scented vernal-grass (*anthoxanthum odoratum*). In no instance that I have observed was this grass eaten by the hares and rabbits, which preyed upon many of the other grasses. Sir H. Davy has shown, that 82 parts of the nutritive matter of this grass consist of 72 parts mucilage or starch, four parts saccharine matter, and six parts of bitter extractive matter, and a peculiar substance which has an acrid taste, more soluble in alcohol than in water. The powerful creeping roots of this grass, its tender nature, and the great deficiency of foliage in the spring, are demerits which discourage the idea of recommending it farther to the notice of the agriculturist.

It comes into flower about the end of April, and perfects hardly any seed; seldom more than two seeds in a panicle are ever found perfect; but few grasses propagate more quickly by the roots.

HOLCUS avenaceus. Tall Oat-like Soft-grass.

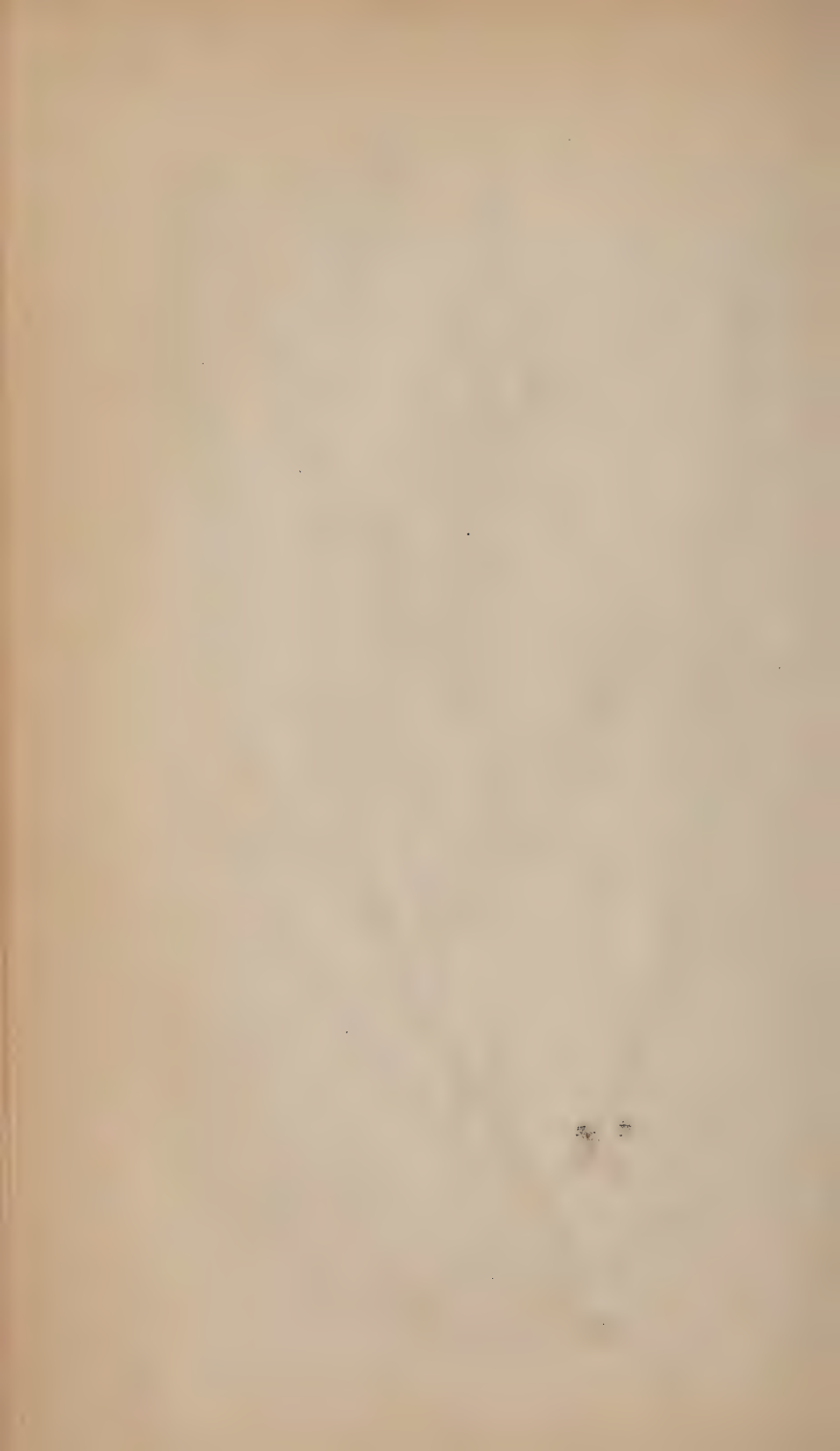
Specific character: Calyx smooth; barren floret lowest, with a sharply-bent prominent awn; fertile one slightly elevated, scarcely awned; leaves rather harsh; root knobbed, or bulbous.

Fig. 1. Calyx. 2. The two florets, showing the bent awn in the outer valve of the lower and barren floret; the fertile floret slightly elevated. 3. Barren floret, with



Holcus

Avenaceus.



its bent awn. 4. Germen, with the stigmas feathered on the upper side. 5. Germen valves, or nectary.

Obs.—In the works of Linnæus, Curtis, and Host, this grass is found under the name of *avena elatior*; under this name it was also received in the first account of the results of these experiments. The jointed and twisted awn, from the back of the blossom, which caused it to rank with the *avenæ*, is frequently wanting altogether, which is evident in the next following variety. It was thought to agree better with the *holci* in structure; it has in consequence been referred to that genus by Scopoli, in the Flora Carniolica; and by Sir James Edward Smith, in the Flo. Brit. and English Botany; indeed, it appears to belong to neither of these justly, but serves to form the connecting link between the *avenæ*, *holci*, and *airæ*.

Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 17,015 lbs. per acre.

The produce of latter-math is 13,612 lbs. per acre.

The proportional value in which the grass at the time of flowering exceeds that at the time the seed is ripe is as 5 to 2, and is superior to the grass of the latter-math in the proportion of 2 to 1.

This grass sends forth flowering culms during the whole of the season, and the latter-math produce, consequently, contains nearly an equal quantity of culms with the flowering crop. It is subject to the disease termed rust, but it does not make its appearance till after the period of flowering; it affects the whole plant, and at the time the seed is ripe the culms and many of the root-leaves are withered and dry from its baneful effects. This clearly explains the cause of the latter-math being superior to the crop at the time the seed is ripe; and points out the propriety of taking the crop as soon as the grass is in flower.

This grass is eaten by all sorts of cattle. Its produce is very great, but the nutritive qualities of the grass are inferior to many other grasses. It pushes rapidly after being

cropped ; and though later in flowering than many other species, produces an early and plentiful supply of herbage in the spring. These properties would entitle it to rank high as a grass adapted for the alternate husbandry, but its nutritive matter contains too large a proportion of bitter extractive and saline matters to warrant its cultivation, without a considerable admixture of different grasses ; and the same objection extends to its culture for permanent pasture. It is always present in the composition of the best natural pastures, and, as before mentioned, eaten in common with other grasses. It does not, however, constitute a large proportion of the herbage, but rather the least of any of the more valuable grasses that have been mentioned.

From the above details it appears that this grass should have a place in the composition of the best natural or permanent pastures, though its proportion, as a constituent, should be much limited. Flowers towards the end of June, and ripens the seed about the second week of July. In dry or fluctuating soils the roots become largely tuberous, and then constitute a troublesome weed.

HOLCUS *avenaceus*, var. *muticus*. Awnless tall Oat-like Soft-grass.

Var.—Flowers without awns.

Obs.—This variety is smaller in every respect than the preceding ; leaves very short ; root slightly bulbous ; panicle much contracted ; glumes pencilled at the apex with purple. Flowers a week later than the awned variety ; in all other respects it is the same.

Native of Scotland.

Experiments.—At the time of flowering, the produce from a rich clayey loam is 12,251 lbs. per acre.

The latter-math is 3,403 lbs. per acre.

This variety is much later, in respect of producing herbage in the spring, and in coming into flower, than the awned variety. It seldom perfects any good seed.

The latter-math produce is very inconsiderable, and but



Bromus Arvensis.

Bromus Mollis.

little nutritive. The nutritive matter contains a little more saccharine matter, in proportion to the other ingredients, than what is contained in the nutritive matter of the awned variety. Hares give a decided preference to the awnless variety. If this grass had merits which entitled it to a place among the superior grasses, it could not be cultivated with advantage, on account of its deficiency of seed, and impatience of being transplanted by parting the roots. It can only be offered, therefore, as a botanical curiosity.

It flowers a week later than the awned variety.

BROMUS *arvensis*. Field Brome-grass.

Bromus racemosus. Smooth Brome-grass.

Specific character: Panicle almost upright, spreading, slightly branched; spikelets ovate oblong, naked; florets imbricated, depressed, ribbed; awns as long as the glumes; leaves somewhat downy. *Fig. 1.* Lower part of a spikelet magnified, showing the calyx, and a floret with the awn on the larger valve of the corolla. 2. Nectary. 3. Germen and short-feathered stigmas.

Obs.—This species resembles, in some measure, the *Bromus multiflorus*; but the spikelets being much more linear, and the brown or purple tinge on the under side of the spikelets, readily distinguish them.

Native of Britain. Root annual.

Experiments.—At the time of flowering, the produce from a sandy loam is 23,821 lbs. per acre.

This species of brome-grass appears, from the results of all my observations, to be confined to rich pastures and meadows, while the next two following species, *bromus multiflorus* and *bromus mollis*, are chiefly found to prevail on poor or exhausted grass lands. They are all strictly annual. This species appears to be the most valuable of the three. When this grass is mown at the time of flowering, it affords a considerable weight of nutritive hay; but when left uncut till the time the seed is ripe, it is then comparatively of no value.

All these annual bromes are considered bad grasses by the farmer. This much, however, may be said in favour of the field brome-grass, that it affords an early bite in the spring, and is eaten by sheep and lambs equally with other grasses. It exhausts the soil but little; the roots penetrate to little depth in the earth. The seed falls from the husks as soon as ripe, and vegetates quickly among the root-leaves of the perennial grasses, and before autumn draws to a conclusion, attains to a considerable size. This grass withstands the effects of frost better than many of the superior pasture grasses: hence it is among the early grasses which afford the principal herbage in the beginning of spring. Being strictly an annual plant, its existence another year depends on suffering it to perfect its seed, and, as before stated, the value of its produce at this stage of growth is very little; so that its merits are reduced to this one, the produce of early herbage in the spring, which will appear insufficient to recommend it for the purposes of cultivation.

It flowers in the second week of June, and till August it sends up flowering culms. The seed is ripe in the first week of July, and successively till the middle of September.

BROMUS multiflorus. Many-flowered Brome-grass.

Specific character: Panicle nodding at the top; spikelets spear-shaped, compressed, naked; flowers imbricated; awn straight; leaves woolly.

Obs.—By attending to the form of the spikelets, this species may readily be distinguished from the *bromus arvensis*, whose spikelets are linear spear-shaped. This is nearer to the *bromus multiflorus* of the E. Bot. than to the *bromus secalinus*; indeed, its alliance to *bromus mollis* is so great, that it may with propriety be considered a variety, permanently larger, of that well-known species.

Native of Britain. Root annual.

Experiments.—At the time of flowering, the produce from a sandy loam is 22,460 lbs. per acre.

On comparing the quantity of nutritive matter afforded by the produce of one acre of this grass at the time of flowering, with that afforded under the like circumstances by the *bromus arvensis*, it manifests a superiority of 266 lbs. per acre. This, and also the superior nutritive qualities of the grass, appear to arise from the greater proportion of culms in the produce of the many-flowered brome-grass; for though the culms of the *bromus arvensis* grow to a much larger size, they are much less numerous than in the produce of the *bromus multiflorus*. The leaves of the *bromus multiflorus* are small in comparison to those of the *bromus arvensis*, and the spring produce of foliage is proportionally less; so much so as 2 to 1. If there were any doubt of rejecting the field brome-grass as unfit for cultivation, there can be none for the many-flowered brome-grass, because it is inferior in almost every respect. It is natural to soils of a less rich nature than those which produce the superior pasture grasses, and the *bromus arvensis*. It flowers about the second week of July, and the seed is generally ripe in three weeks afterwards.

BROMUS *mollis*. Soft Brome-grass.

Specific character: Panicle erect; spikelets oval and oblong, a little compressed, covered with down; flowers imbricated; outer husk of the blossom divided at top; awn straight, about the length of the husk; leaves soft and downy.—*Fig.* 1. Calyx. 2. Floret. 3. Nectary. 4. Germen, or rudiment of the future seed.

Obs.—The panicle branches are simple, seldom supporting more than one spikelet. In the *bromus arvensis* and *bromus multiflorus* the panicle branches are branched, and some of them simple. The oval oblong figure of the spikelets, and the downy hairs which cover them, are characters which readily distinguish this species from the others.

Experiments.—At the time of flowering, the produce from a sandy loam is 10,890 lbs. per acre.

On all poor exhausted soils that have been injudiciously laid down to grass, this species is more common than on any other land. It very much resembles the two last-mentioned species of *bromus* in appearance and habits, but flowers several weeks earlier, and the seed is generally ripe before hay harvest commences. This circumstance, which is an unfortunate one to the farmer, is favourable to the soft brome grass, as it secures its existence for another season. From the above details, it appears to be greatly inferior to the field brome grass, and many-flowered brome. It produces but little foliage in the spring; and the flowering culms are soon formed, and become nodding at top, or bent downwards with the weight of the seed, which is large, and much relished by birds. When once this grass introduces itself into a field, it is a very difficult task to overcome it; for, though an annual, or one-year-lived plant, like the other two bromes, and though cut when in flower, it will, nevertheless, continue to send up fresh culms from the root till a late period of the season; and these late or secondary culms being of a very low stature, are seldom perceived, but on a close inspection of the herbage. Thus it happens, that after sacrificing the crop of hay (which, however, is never great if this grass prevails), by mowing the field when this grass is in flower, and before the other pasture grasses have attained to any degree of maturity, the soft brome-grass next season makes its appearance in abundance, as before. One remedy is, therefore, to mow repeatedly, as the flowering culms make their appearance, till the roots of the annual grass are exhausted, and then to apply sufficient top-dressings to compensate the soil for the want of the grazing manure. But prevention is most to be recommended; and that is effected by judicious cropping, and never suffering the land to become too poor or exhausted: when this is faithfully performed, the soft brome will but seldom appear, or will soon be overcome by its more powerful neighbours. This grass, however, sometimes makes its appearance on a sudden in lands that were before strangers to it, which is caused by its seed being mixed with that of the grain or grass-seed used in

sowing the land. It may therefore be worthy the notice of the agriculturist to examine such seeds before they are committed to the soil.

It flowers about the middle of May, and ripens the seed about the first or second week of June.

Geese are remarkably fond of the seeds of this grass, and, if they have access to an orchard or meadow where it grows, will touch nothing else.

FESTUCA loliacea. Darnel-like Fescue.

Specific character: Spike two ranked, drooping; spikelets nearly sessile, linear-oblong; florets cylindrical, awnless, pointed, with five slight ribs at the top.

Obs. — This grass at first sight greatly resembles the *lolium perenne* (ray-grass); but, on a closer inspection, the calyx or outer husk, so conspicuous in the spikelets of the ray-grass, is in the spikelets of this grass almost wanting. The spikelets are also arranged in a different manner: in the ray-grass they stand facing the spike-stalk; but in the darnel-like fescue, they stand with their back towards it. Native of Britain. Root fibrous. Perennial.

Experiments. — At the time of flowering, the produce from a rich brown loam is 16,335 lbs. per acre.

The latter-math produce is 3,403 lbs. per acre.

The proportional value which the grass, at the time the seed is ripe, bears to that at the time of flowering, is as 13 to 12; and the grass of the latter-math stands in proportion to that at the time of flowering, as 12 to 5, and to that at the time the seed is ripe, as 13 to 5.

This species of fescue is very much like the ray-grass in appearance; it likewise affects the same kind of soil. Some botanists have supposed it to be a hybrid, the joint produce of the *lolium perenne* and *festuca fluitans*; but the time when the *lolium perenne* comes into flower, is nearer to that in which the meadow fescue is in flower, than the flote fescue; the soil and habits of the two former grasses are likewise more similar.

From the above details, it appears that this species of fescue is much superior to ray-grass in point of produce. This grass likewise springs earlier than the ray-grass, and improves by age, which is not the case with common ray-grass, as it decreases in value, with respect to produce and early growth, after the fourth year of its being sown, while the darnel-like fescue improves in these properties after that period of growth. Unfortunately, however, this grass does not perfect its seed, the flowers generally proving abortive; which renders its cultivation, or rather propagation, inconvenient and expensive. By parting the roots, and transplanting them, it might readily be propagated; but its merits hardly warrant the practice. In rich meadows this grass is very common, particularly where the land is periodically overflowed. In a piece of meadow ground on the banks of the river Trent, near Nottingham, I found this grass to constitute the principal herbage.

It flowers in the last week of June, and ripens the seed (if any) in the third week of July.

FESTUCA glabra. var. Smooth Fescue.

Specific character: Panicle branched, upright, compact; spikelets spear-shaped, four to six-flowered, smooth, awned. Root fibrous.

Obs.—This is nearly allied to the *festuca duriuscula* and *festuca rubra*; it differs in having the awns longer, panicle branches and spikelets smoother; spikelets shining, root scarcely creeping, root-leaves much longer. This is, according to Sir James Edward Smith, a variety of the *festuca rubra*. To the agriculturist, the distinction, creeping root, is sufficient to guide him in this instance, as the varieties of the creeping-rooted species are all to be rejected as less desirable for cultivation; and among the fibrous-rooted varieties of the *festuca duriuscula*, there is not so great a difference in their comparative value, as to render the adoption of one for the other of so much importance as in many other instances, where the distinctions are equally minute. Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam with manure is 14,293 lbs. per acre.

The produce of latter-math is 6,125 lbs. per acre.

The proportional value, in which the grass at the time of flowering exceeds that of the latter-math, is as 4 to 1; and the grass, at the time the seed is ripe, exceeds that of the latter-math in the proportion of 5 to 2.

From the above details, which show the produce of this grass, it appears to be inferior to the *festuca duriuscula*, which will be manifest on a comparison of the former details respecting the *festuca duriuscula* with the above. In regard to early produce, however, this grass is superior. The herbage is uncommonly fine and succulent. But these merits appear hardly sufficient to compensate for the deficiency of produce. If its merits be compared with those of some of the early grasses, the *anthoxanthum odoratum* for instance, it will be found superior.

Though this grass cannot be recommended in preference to the *festuca duriuscula*, yet it is evident, from the above details, that among the fine-leaved fescues, it is the best substitute for that species where it is wanting. It is not so common as the *festuca duriuscula*, being more confined to the moist spots of the pastures, though occasionally found also on the drier places, in company with it. Flowers in the second week of June, and ripens the seed in the second week of July.

POA nemoralis, var. *angustifolia*. Wood Meadow-grass.

Specific character: Panicle capillary, flowering a little on one side, diffuse; spikelets lanceolate, mostly three-flowered; florets hairy at the base, without a web.

Obs.—The sheath-scale is very short, and truncated; straw rather compressed than otherwise, vagina smooth, root stoloniferous. Hardly any grass varies more than the *poa nemoralis* var. in the number of florets contained in the calyx. When the *poa nemoralis* var. *angustifolia* is raised from seed, in open situations, the first year, the calyx contains only from three to five florets; afterwards, the number increases to nine florets in each ca-

lyx: when raised from seed in shady situations, it has frequently only two florets in each calyx, and sometimes only one, the first year; the number does not increase afterwards to more than three florets in each calyx. In its natural place of growth, *poa nemoralis*, in woods under the shade of trees, contains only three florets, and, when long cultivated in exposed situations, the calyx is four and five-flowered. The next following grass, though a distinct species, resembles this in several of its agricultural merits. Root fibrous and stoloniferous. The plants of *poa variegata*, cultivated in the Woburn Abbey Experimental Grass Garden, were communicated to the Duke of Bedford by my friend Mr. Anderson, of the Botanic Garden, Chelsea.

Experiments. — At the time of flowering, the produce from a brown loam is 9,188 lbs. per acre.

This grass springs early, but the produce is inconsiderable, compared to that of many others equally nutrient. It is seldom, or, according to my experience, never found in a natural state, except in woods and under the shade of trees. Nevertheless, the seeds vegetate readily when sown on exposed situations; and the plants grow freely, and attain to a greater size and strength, than those in the woods and in the shade. It is singular, that before the period of coming into flower, the plants that are thus cultivated are invariably attacked by the disease termed *rust*, which pervades every part of the plant. In moist and cloudy seasons the disease is much less severe, being chiefly confined to the leaves. I never could observe the least trace of this affection in the plants of this species while in their natural place of growth. The tall oat-like soft grass (*holcus avenaceus*), which affects the shade, and is subject to the above disease, is always free from this affection when growing in the shade. It is likewise precisely the case with the *agrostis stolonifera*, var. *sylvatica*, or wood stoloniferous bent-grass. There are grasses which are also peculiarly confined to woods or shady situations, but which continue free from this disease when transplanted to exposed situations, as the wood millet-grass (*miliun effusum*), hairy wood brome-grass (*bromus hirsutus*),

and tall brome-grass (*bromus giganteus*). There exists no difference in the structure of those grasses subject to the disease, to distinguish them from those that are always affected by it when transplanted to exposed situations, only that the former grasses are smooth, or have their surface free from hairs, while the latter are in general hairy, or have their surface furnished with numerous hairs. The *bromus sylvaticus* (wood brome-grass), and *festuca pinnata* (spiked wood fescue), are subject to the rust likewise, when taken from their natural places of growth: these grasses have hairs, but they are minute, and thinly scattered on the leaves. The early growth of this grass in the spring, and its remarkably fine, succulent, and nutritive herbage, recommend it strongly for admission into the company of the superior permanent pasture grasses.

The wood meadow-grass flowers in the third week of June, and ripens the seed in the end of July.

POA angustifolia. Narrow-leaved meadow-grass.

Poa pratensis, var.: Panicle diffused; spikelets four-flowered, pubescent; culm erect, round.

Obs.—Sir James Edward Smith regards this as a variety of the *poa pratensis*, and its botanical characters are certainly not sufficient to constitute it a species distinct from *poa pratensis*; but as it differs much from that species in its agricultural merits, being much superior, I have kept it distinct from that species, that it may more readily impress the memory. Native of Britain. Root creeping. Perennial.

Experiments—At the time of flowering, the produce from a brown loam is 18,376 lbs. per acre.

The produce of latter-math is 12,251 lbs. per acre.

The proportional value in which the grass, at the time the seed is ripe, exceeds that at the time of flowering, is as 21 to 20.

In the early growth of the leaves of this species of *poa*, there is a striking proof that the property of coming early into flower is not always connected with the early growth and produce of herbage in the spring. In this respect,

most of the grasses that have come under examination are inferior to this now spoken of. Before the middle of April, the leaves attain to more than twelve inches in length, and are tender and succulent. In the month of May, likewise, when the flowering culms make their appearance, it is not subject to the disease that affects the foregoing species; the bad effects of which were manifested in the great deficiency of produce in the crop at the time the seed was ripe, being one-half less than at the time the grass is in flower. Though the disease begins in the straws of the *nemoralis*, the leaves suffer most from its effects, being, at the time the seed is ripe, completely dried up. The culms therefore constitute the principal part of the crop at the time the seed is ripe, and they contain more nutritive matter in proportion than the leaves. When the grass of the *nemoralis* is cut before the time of flowering, the disease makes but small progress, or does not make its appearance if the grass is kept closely cropped. The *poa nemoralis* has also the property of sending up flowering straws till a late period of the season, and when cut only thrice in the season, the latter-math is considerable.

The property of early growth in the spring, which this grass, *poa angustifolia*, possesses, recommends it for the purpose of permanent pasture. It sends up flowering culms successively for several weeks. In this it differs from the *poa pratensis*, which produces culms only once in the season. The root is as powerfully creeping as that species, but for which, it might rank with the most valuable grasses. It contains more nutritive matter than the *poa pratensis* or *poa trivialis*. Its spring produce is nearly double that of either of these grasses; and it is perfectly exempt, as before observed, from the disease that detracts so much from the merits of the *poa nemoralis*, var. *angustifolia*, which nearest approaches to this species, in the superiority of early and abundant herbage in the spring. It flowers towards the end of May, and the seed is ripe about the third week of June. The culms are most valuable for the manufacturer of the finest straw-plait, in imitation of the celebrated *Leghorn*.



Poa Fertilis

The seed of a species of grass was received from America, under the name of *spear grass*, by Joseph Sabine, Esq. secretary to the Horticultural Society, and communicated by that gentleman to the Duke of Bedford. This grass was stated to be the same as that which Miss Woodhouse, in America, used in the manufacture of her prize bonnet in imitation of *Leghorn*. This seed was sown in the grass garden at Woburn Abbey, and the plants raised from it proved to be those of *poa pratensis*, or smooth-stalked meadow-grass.

Plants of the *American grass*, as it is sometimes called, were also received from Mr. Anderson, of the Botanic Garden, Chelsea, which proved to be identical with the *poa pratensis*.

POA *fertilis*. Fertile Meadow-grass.

Specific character: Panicle loose, spreading; spikelets oval, spear-shaped, five-flowered; florets connected at the base by woolly hairs; husks generally five-nerved, sheaths of the culms a little rough; straw somewhat compressed; roots slightly creeping. *Fig.* 1. Spikelet, magnified. 2. Corolla and anthers. 3. Germen. 4. Seed.

Obs.—This grass seems to be allied to the *poa nemoralis*. It differs in having the panicle more loose and spreading, and less attenuated. The spikelets are more oval and nerved, otherwise the number of florets might occasion a doubt. The culm rises from a foot and a half to two feet in height, and sometimes more; ascending at the base, afterwards erect, somewhat compressed. In long-continued moist weather the lower joints send up flowering culms. The panicle is erect, and spreading when in flower, but contracted and drooping when the seed is ripe. Native of Germany. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam is 15,654 lbs. per acre. The produce of latter-math is 4,764 lbs. per acre.

The proportional value which the grass of the latter-math bears to that at the time of flowering, is as 3 to 6; and to the grass at the time the seed is ripe, as 3 to 10.

In regard to early growth, this grass stands next to the meadow fox-tail, cock's-foot, and tall oat. The herbage is more nutritive than that of either of these grasses. It will appear remarkable, that the grass of the latter-math should contain more nutritive matter than the grass at the time of flowering; but this is owing to the property it possesses, of sending forth a succession of flowering culms till the frost arrests it; and hence the trivial names, *fertilis* and *serotina*, fertile and late-flowering meadow-grass, quoted above. M. Host mentions, that it is natural to moist pastures and the banks of rivers; and Schrader remarks also, that in Germany it grows in meadows, vineyards, marshes, walls, and elsewhere, not unfrequently. I have found it to grow on almost every kind of soil; but it attains to the greatest perfection in a rich moist one. Hares and rabbits are very fond of it. It is one of those grasses that thrive best when combined with others: it will not make a superior turf of itself, but it adds much to the value of a sward from its nutritive qualities and powers of early and late growth. As it perfects an abundance of seed, it may be easily propagated.

By comparing its produce of nutritive matter, from one acre, with those of the cock's-foot, meadow-foxtail, and sweet-scented vernal grasses, it will be found superior to foxtail in the proportion of 5 to 3, and only inferior to the cock's-foot in the proportion of 7 to 5.

Sir Humphry Davy has shown that its nutritive matter consists of mucilage, 65; saccharine matter, or sugar, 6; extractive matter, 7=78.

From these facts and observations it will appear, that the fertile meadow-grass deserves a place in the composition of rich pastures, and ranks with the superior grasses of irrigated meadows.

It flowers in the beginning of July, and the seed is ripe towards the end of the month.

LATHYRUS *pratensis*. Yellow Vetchling, Tare Everlasting.

Specific character: Tendrils with two leaves, quite simple; leaflets spear-shaped.

Tendrils sometimes three-cleft. Native of Britain. Root creeping. Perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 24,502 lbs. per acre.

The merits of this vetchling, in point of produce and nutrient qualities, appear to be much inferior to those of the red or broad-leaved cultivated clover.

It is not unfrequent in good pastures and in rich meadows: it delights in moisture, and it attained to the greatest perfection in a tenacious clayey soil. It is a late-springing plant, and the shoots come up thinly, but attain to a great length. It appears to be eaten by oxen, cows, and sheep, but with less relish than they seem to have for the *Vicia sepium* (creeping vetch), or the red and white clovers.

Sir Humphry Davy has shown, that the plants most liked by cattle have either a saline or subacid taste, as in the instances of red and white clovers, and the superior grasses. This plant, however, has a greater excess of the bitter extractive and saline matters, in proportion to that contained in these plants, when compared to the rest of the pasture grasses. It is nauseous to the taste. From these facts and observations, it does not seem to be a plant that possesses unequivocal merits for admission into the composition of pasture. It attains to the greatest size on tenacious clayey soils.

POA *nervata*. Nerved meadow-grass.

Specific character: Panicle upright; spikelets smooth, five-flowered, nerved.

Obs.—Panicle often half a foot and more in length, with slender branches, pressed close, and subdivided; spikelets small, of a green colour; valves of the blossom smooth, having five raised nerves on each valve; leaves

in two rows, resembling a fan, somewhat rough; culm a little compressed.

Native of North America. Root perennial.

Experiments.—At the time of flowering, the produce from a rich sandy loam is 21,780 lbs. per acre.

The produce of latter-math is 9,528 lbs. per acre.

The crops of this grass, at the time of flowering, and at the time the seed is ripe, are equal in point of quantity and nutrient quality, a circumstance which has not occurred in any other grass mentioned in this series of experiments. The nutritive matter contained in the latter-math is likewise greater than in most other grasses. The root-leaves are produced on a shoot, and stand in two rows after the manner of a fan. This shoot, which is formed by the union of the base of the leaves, is very succulent, and contains a greater proportion of nutritive matter than the leaves, which accounts for the superiority of the latter-math in nutritive matter. This grass is remarkably hardy. In February 17, 1814, after the severe winter preceding, this species of *poa* was perfectly green and succulent, while not one species of grass, out of nearly three hundred different species that grew around it, remained in a healthy state, but were all inferior, and more or less injured by the severity of the weather. In the following season, the produce rather exceeded the above, though it had been mown the preceding season, and no manure had been applied. It is a native of North America, where the winters are longer or more severe, and the summers warmer than in this climate; and the plants, natives of Siberia, exhibit a similar habit, for the severer the winter, the greater is their produce; and the milder the winter, their produce is comparatively less. The long-rooted clover is one of this class: after a severe winter the produce is very great, but after a mild winter the produce is considerably inferior*.

The nerved meadow-grass affects most soils, but not such as are tenacious. The seed does not vegetate so readily as

* This is the case with the greater part of the grasses; the more they grow in winter, the less they grow in summer.—ED.

might be presumed from the plentiful manner in which it is produced; nor does the plant attain to maturity so soon as many other grasses that have equal merits in other respects. The above facts do not offer sufficient ground to recommend the nerved meadow-grass strongly, for the purposes of the agriculturist; nor go the full length to discourage further attempts to cultivate it to more advantage, as it is a foreign plant, and its defects may probably be lessened by frequently raising it from seed ripened in this climate.

Farther experience in the cultivation of this grass enables me to state, that it possesses very valuable properties, and that it will be found a valuable ingredient in permanent pastures, where the soil is not too dry, but of a medium quality as to moisture and dryness.

It flowers in the third week of June, and the seed is ripe in the last week of July.

POA glauca cæsia. Sea-green Meadow-grass.

Specific character: Spikelets ovate. Florets from two to five, obscurely five-ribbed, bluntish; silky at the keel and lateral ribs; hairy at the base, without a web. Stipulas of the lower leaves very short and blunt.

Obs.—Culms from six inches to a foot and a half, according to the nature of the soil it grows in. The leaves are bluntish, flat and smooth on the back next the base, but in other parts rugged; sheaths the length of the leaves, striated, somewhat rugged. It seems to be very different from the *poa glauca* in the Flora Danica; that approaches nearer to the *poa nemoralis*. Whole plant of a deep glaucous colour. Native of Scotland. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a brown loam is 6,806 lbs. per acre.

At the time the seed is ripe, the produce is 4,764 lbs. per acre.

The weight of grass at the time the seed is ripe is less than that at the time of flowering; which at first sight appears contrary to what might have been expected, as the

grass had at least three weeks of growth more than that of the flowering crop. But after the time of flowering, the leaves do not appear to increase, but rather diminish, many of them becoming completely dry before the seed be perfected. The culms retain their succulency, and become heavier till the seed be ripe ; which points out the true cause of the superior quantity of nutritive matter contained in the grass of the seed crop.

Sir James Edward Smith informs us, that it is an alpine plant, and only as yet found a native of Scotland, where it was found by Mr. Mackay, on Ben Lawers. It appears, however, to be easily cultivated on soils of an intermediate quality as to moisture and dryness. Its seed is good, and produced in plenty.

The above details prove this grass to be capable of cultivation ; but possessed of no excellence in a sufficient degree to render it worthy of a place in the composition of good pasture on soils of the best quality.

It flowers in the third week of June, and the seed is ripe about the second and last week of July, according to the state of the weather.

POA glauca. Glauous Meadow-grass.

Specific character: Panicle spreading, spikelets ovate ; florets from two to five, obscurely five-ribbed, bluntish, silky at the keel and lateral ribs, hairy at the base, without a web ; stipulas of the lower leaves very short and blunt.

Obs.—This species resembles the *poa nemoralis*, and, in a less degree, the *p. trivialis*, and likewise affects a similar soil ; while the preceding variety of it resembles more the *poa alpina*, *poa subcærulea* and *poa pratensis*, and like these, affects a somewhat drier soil. Culms from a foot and a half to two feet in height. Whole plant of a light pale glaucous colour. Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a rich black sandy loam is 8,848 lbs. per acre.



Phleum Pratense *Mayus*

This grass is said to be a native of the north of England, and Scotland. It inhabits alpine situations, but is easily propagated, as it perfects plenty of seed, which vegetates freely on almost every kind of soil. It grows to a larger size than the sea-green meadow-grass; and if the above details of its produce and nutritive powers be compared with those of that grass, it will be found greatly superior. But it is still much inferior to a great number of grasses, in the quantity of herbage, hay, and nutritive matter it affords; and in other respects it possesses no superior merit, either with respect to early growth, reproductiveness, or late growth. It cannot therefore as yet be recommended as a plant for the purposes of the agriculturist.

It flowers in the third week of June, and the seed is ripe about the end of July.

PHLEUM *pratense*. Meadow Cat's-tail Grass. Timothy-grass.

Specific character: Spike cylindrical, very long; calyx fringed and awned; straws upright. *Fig. 1.* Calyx magnified, showing the fringes. *The same*, of the natural size. 2. Corolla and stamens. 3. Nectary, germen, and stigmas, with the long styles.

Obs.—Culms from a foot and a half to three feet high, according to the nature of the soil in which it grows; in moist deep loams it attains the greatest height. Spike regularly cylindric, and blunt at the top; sometimes five or six inches long in young plants, but in old plants it is much shorter. Compare the husks of the florets with those of the following variety (*phleum pratense*, var. *minus*), and likewise with those of the next following species (*phleum nodosum*, bulbous-jointed cat's-tail grass), and they will be found much shorter and straight in the forks or dagger-like points which terminate them. This is a sure distinction, the length of the spike being a very uncertain character, for the reason just now mentioned. Root fibrous, sometimes inclining to a bulb. Native of Britain. Perennial.

Experiments.—About the middle of April, the produce from a clayey loam is 5,445 lbs. per acre.

The produce of latter-math is 9,528 lbs. per acre.

The culms of this grass at the time the seed is ripe contain more nutritive matter than those of any other species of grass that have been submitted to experiment. In regard to the production of early herbage in the spring, it is superior to the cock's-foot grass; the results of the experiments showed the quantity of grass to be equal in both plants; but the nutritive matter afforded by the grass of the meadow cat's-tail in the early part of the spring, was superior to that of the cock's-foot, in the proportion of 9 to 8. The value of the culms simply, exceeds that of the grass, at the time of flowering, in the proportion of 14 to 5; a circumstance which gives value to this grass above many others for the purpose of hay; as its valuable early foliage may be cropped to a late period of the spring without injury to the culms, which cannot be effected with those grasses which flower earlier in the season, without incurring a loss of nearly half the value of the crop, as has been proved by former examples.

Though there is more nutritive matter contained in the seed crop than in the flowering crop, nevertheless the loss of latter-math which would have been produced in the time the seed was ripening, would more than outweigh the superior quantity of nutritive matter contained in the grass of the seed crop. To the practical farmer this last observation (which likewise applies to every similar statement throughout these details) is, I am sure, unnecessary. If the season has been dry, this grass should be cut at the time of flowering; but in moist cloudy seasons it should be suffered to stand at least eight days after the period of flowering; in two days after this period it will accumulate more nutritive matter than it did in ten days previous to that stage of growth, provided circumstances do not interrupt the progress of vegetation, which the results of numerous experiments have proved.

This grass is very deficient in the produce of after-math, and is slow in growth after being cropped: these defects



Phleum Pratense,
Minus

take much from the merits above mentioned. It appears, therefore, to be unfit for cultivation by itself as an alternate husbandry grass; but of great value as a constituent of any mixture of grasses for permanent pasture, or the alternate husbandry, where it should always form a part.

In the Annual Register for 1765, we find that it was much recommended about fifty years ago, under the name of Timothy-grass; and Mr. Wynch is said to have brought it from Virginia in 1763. It received this quaint appellation from Mr. Timothy Hanson, who first brought its seeds from New York to Carolina. It had then a great character in America, where it is called Herd-grass. I was, in 1815, informed by a proprietor of land in Canada, that it is still considered the best grass in that province.

It flowers in the third week of June, and ripens the seed in the end of July.

PHLEUM *pratense*, var. *minus*. Smaller variety of Meadow Cat's-tail Grass.

Obs.—This differs from the preceding variety in the dagger-like points which terminate the husks, these being longer in this variety, and more recurved or bent outwards; the husks are larger in every respect, and less ciliated. Culms almost covered with the sheaths of the leaves; joints of the culm less swoln, not upright, but ascending; and the root is more like a bulb. These distinctions have continued stedfast after the plant has been twice raised from seed. The annexed specimen was produced from the second sowing. The foregoing specimen of the first variety is also of the second sowing; both varieties were raised on the same soil, and, indeed, on the same bed of earth. *Fig. 1.* Calyx magnified. Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 14,973 lbs. per acre.

The produce of latter-math 9,528 lbs. per acre.

A comparison will show how inferior this smaller variety of meadow cat's-tail grass is to the larger variety. The

former grass is superior to this one, in the proportion nearly of 25 to 8. This shows how important a point it is to distinguish one variety of grass from another, when they are so very much alike in outward characters as in the above instance. The seeds are also very similar to each other, or rather the marks which distinguish them from each other are minute. This is much later in the produce of herbage in the spring than the larger variety, and it is much less nutritive. It is more common on tenacious soils than in such as are rich, in company with the true meadow cat's-tail. It flowers and perfects its seed about a week later than the preceding variety.

PHLEUM nodosum. Bulbous-jointed Cat's-tail Grass.

Specific character: Spike cylindrical; culm knee-bent, furnished with bulbs at the lower joints, which send out branches.

Obs.—There is still another variety of the *phleum pratense*, distinct from the preceding, and which may be mistaken for the *phleum nodosum*: that variety grows on poor clayey soils, particularly by road-sides. It approaches to the present species, in having the root somewhat bulbous; the straw is likewise ascending, but not knee-bent, as in the *phleum nodosum*: these characters continue constant when the plant is cultivated on different soils, *i. e.* on light sandy soil, heath soil, and tenacious clay. It is smaller in every respect than the two varieties of which specimens have been given. The *p. nodosum* differs from the *p. pratense* in having knee-bent culms, bulbs growing out at the root of the stem-leaves, which in time become plants. Culm leaves shorter and smooth, except at the edges. Anthers white. The dagger-like points of the husk are also longer, and more reflexed than in those of the *phleum pratense*. Native of Britain. Root bulbous. Perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 12,251 lbs. per acre.

The above details show that this species of meadow cat's-tail is much inferior even to the lesser variety of the *phleum pratense*. It is a very scarce grass, at least as far as my researches have extended, having found it but in one meadow in a wild state. It grows in a clayey soil near a spring in Woburn Park, from which the annexed specimen was propagated. Hares and rabbits neglected this grass for the common cotton grass (*eriphorum angustifolium*), which grew closely adjoining.

It flowers in the second week of July, and ripens the seed in the end of the same month: but the seed is seldom good.

CYNOSURUS *erucæformis*. Linear-spiked Dog's-tail grass.

Specific character: Spike compound; spikelets scattered, the fruit-bearing ones erect; calices one and two-flowered; husks obtuse, boat-shaped; keel obtuse; corollas acuminate.

Obs.—This grass is marked an annual in botanical works, but it is strictly perennial. Before the time of flowering the spikelets are beautifully tinged with crimson on the sides; it deserves a place in the flower-garden, on account of the singularity and beauty of the spike. Native of Germany, Russia, and Hudson's Bay. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 6,806 lbs. per acre.

The produce at the time the seed is ripe, was taken the season preceding that in which the flowering crop was submitted to experiment; and as the season of 1812, in which the seed crop was ascertained, happened to be more favourable to the growth of this grass than that of 1813, when the flowering crop was experimented upon, and the seed crop likewise, according to the following details of results, it will be more just to compare the produce of the crops of the same season.

At the time the seed is ripe, the produce of the season in which the flowering crop was ascertained is 6,125 lbs. per acre. The produce of latter-math is 3,062 lbs. per acre.

I have never been able to obtain any seed from this grass that when sown would vegetate, though in general it appears good to the eye. I have tried it on three different soils, but without success. It thrives best on a rich deep loam, and, next to that, on a clayey loam: when cultivated on a sandy siliceous soil the produce is very inferior; on this account it is introduced in this place. It might be propagated to any extent by parting the roots; but its merits, as will appear from the above details, do not warrant any recommendation to that effect, but rank it with the inferior grasses.

It flowers in the third week of June, and the seed is perfected about the third week of July.

TRITICUM *caninum*. Bearded Wheat-grass.

Specific character; Calyx-valves somewhat awned, with three or five ribs; florets four, awned; leaves flat; root fibrous.

Obs.—This differs essentially from the common couch-grass (*agropyrum repens*), in having the root fibrous; the awns are also much longer than those of the awned variety of common couch. Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam is 12,251 lbs. per acre.

The crop, at the time of flowering, is of greater proportional value than that at the time the seed is ripe, nearly as 6 to 5.

The produce of latter-math is 3,062 lbs. per acre.

It appears that this grass is of considerable value, more particularly as it affords herbage early in the spring, in a degree superior to ray-grass, sweet-scented vernal, and nearly equal to the meadow fox-tail. It produces a sufficiency of seed, which vegetates quickly; and the plants soon arrive at perfection in almost every kind of soil, except in such as are tenacious or retentive of moisture. If to these valuable properties it added late growth, or a proportional supply of latter-math, it would rank high among the superior grasses; but in this it is deficient, as are most of the grasses which

produce early foliage in the spring: the cock's-foot, tall oat-like soft-grass, Taunton's meadow-foxtail, and meadow soft-grass, are the only exceptions, properly, to this point.

On soils of an inferior quality it might be cultivated to advantage instead of ray-grass; but for soils of the best quality it does not as yet uphold a sufficient claim, the awns of the spike being objectionable. It flowers about the first and second week of July, and the seed is ripe generally about the end of July and beginning of August.

BROMUS erectus. Upright Perennial Brome-grass.

Specific character: Panicle upright, slightly branched; spikelets linear-lanceolate; florets about eight, loosely imbricated, lanceolate, compressed; awns shorter than the glumes, straight; radical leaves very narrow, fringed with scattered hairs.

Obs.—The awns are a continuation of the keel of the blossom, thus forming the connecting link between this genus and *festuca*. Corolla with a large knot at the base, hairy, outer valve ribbed and keeled; awn shorter than the blossom; anthers of a beautiful saffron colour. Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a rich sandy soil is 12,931 lbs. per acre.

Mr. Curtis has remarked of this grass, that it is peculiar to chalky soils, and that its appearance in a wild state is much less favourable than when cultivated in a garden. I have found it on rather low-lying sandy soils, as in some parts of Woburn Park, where it appeared as luxuriant as when cultivated in the grass-garden. But the fact is, the culms rise to a considerable height, and the root-leaves are but few in number, though growing to some length; the grass, by this means, appears to be much more productive than it really is. It seems to be but little relished by cattle, the leaves being rough with hairs. I have not had an opportunity to examine it while growing on chalky soils in a natural state, nor submit it to experiment on a soil of that nature; however useful, therefore, it may be found hereafter

on chalky soils, it is evident, from the above details, that it is but little adapted for the best pasture land. It flowers rather early, but the foliage is comparatively late in growth.

Pheasants appear very fond of the seed; they frequently pick off the spikelets before the seed is perfected. The seed is afforded in very small quantity.

Flowers in the second and third weeks of June, and the seed is ripe in the second and third weeks of July.

BRIZA media. Common Quaking-grass. Ladies' Tresses.

Specific character: Spikelets ovate, about seven-flowered; calyx shorter than the florets; stipula very short and blunt. *Fig.* 1. Spikelet magnified. 2. Corolla. 3. Seed, coated with the outer valve of the corolla. 4. Germen, nectary, stamens, styles, and stigmas.

Obs.—Stems from half a foot to a foot and a half high, according to the nature of the soil it grows on. In moist soils it attains to the greatest size. Dr. Withering remarks, that if a seed be carefully dissected with a fine lancet, the young plant will be found with its leaves and roots perfectly formed. Professor Martyn observes, that it is easily distinguished as a species of *briza* by the shaking disposition of its panicle; whence its name amongst ancient authors, "*gramen tremulum.*" The French call these quaking-grasses "*amourettes.*" Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a brown loam is 9,528 lbs. per acre.

The latter-math produce is 8,167 lbs. per acre.

It appears that the weight of nutritive matter, which is lost by taking the crop at the time of flowering, exceeds one-seventh part of its value; and the nutritive matter contained in the grass of the seed crop exceeds that in the flowering grass, in the proportion of 13 to 11, and that of the latter-math as 13 to 8.

The results of the experiments on the three different soils now mentioned show this grass to be best fitted for poor soils, and afford one instance, that manure is even hurtful to some



grasses. Its nutritive powers are considerable, when compared to other grasses affecting a similar soil. It is eaten by horses, cows, and sheep. These merits, therefore, demand attention, and though it is unfit, comparatively, for rich permanent pasture, yet, for poor sandy, and also for poor tenacious soils, where improvement in other respects cannot be sufficiently effected to fit them for the production of the superior grasses, the common quaking-grass will be found of value.

It flowers in the second and third weeks of June, and the seed is ripe about the second week of July.

BROMUS inermis. Smooth awnless Brome-grass.

Specific character: Panicle upright; spikelets linear, cylindrical, naked, awnless, or with very short awns sometimes, imbricated; leaves smooth.

Obs.—Root powerfully creeping, like common couch-grass. Culms from a foot to two feet high, erect, scored, smooth. Leaves broad, acuminate, smooth, dark green, mid-rib whitish, and rough. Panicle from six inches to a foot and more in length; at first contracted and upright, afterwards nodding. Native of Germany. Root creeping. Perennial.

Experiments.—At the time of flowering, the produce from a black siliceous sandy loam is 12,251 lbs. per acre.

The produce of latter-math is 8,848 lbs. per acre.

In Germany, where this grass is a native, it grows in moist pastures, orchards, and by the banks of rivers. Its root is powerfully creeping, like the common couch-grass, and possesses the property of impoverishing the soil in as eminent a degree as that grass. Its produce, when first planted on a soil, is much greater than afterwards, on account of its exhausting nature. The produce of early foliage is inconsiderable, and less nutritive than many others. To the eye it produces an abundance of seed, but, in general, it is imperfectly formed, and, when sown, produces few plants in proportion to the quantity of seed employed. The merits of this grass will appear, from the above details, to be inferior

to most of the grasses that have already come under observation, and offer no grounds on which to recommend it to the notice of the agriculturist.

The smooth awnless brome-grass flowers in the second week of July, and ripens the seed in the second and third weeks of August.

MELICA ciliata. Ciliated Melic-grass.

Specific character: The outer petal of the lower floret ciliate; panicle spike-like; spikelets erect.

Obs.—Culms from one to three feet high, according to the quality of the soil. Leaves spear-shaped, mucronate, from three to nine inches long, smooth underneath, slightly pubescent above, somewhat rugged downwards, a white nerve runs along the back. Sheath-scale white, cloven; sheaths striated, the lower a little pubescent and rugged, the upper ones smooth and glossy; but as the seed approaches towards perfection, it becomes feathered with long woolly hairs. Native of Germany. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a rich sandy loam is 6,806 lbs. per acre.

The produce of latter-math is 2,041 lbs. per acre.

The above facts show this grass to be one of the inferior species with respect to produce, nutritive qualities, and reproductive powers. In Germany it grows wild on hilly grounds, downs, and by the margin of woods; it may be ranked with the glaucous and sea-green meadow grasses (*poa glauca et poa casia*). Among the grasses not natives of Great Britain, that have been brought under observation in the course of these details, two species only have offered proofs of fitness for the purpose of permanent pasture, on soils of the best quality; nerved meadow-grass (*poa nervata*), and fertile meadow-grass (*poa fertilis*); the superior merits of these over many other grasses have already been considered.

It flowers in the third week of June, and the seed is ripe about the second week of July.



Vicia Sepium.

VICIA sepium. Bush Vetch.

Specific character: Legumes pedicelled, mostly four together, erect, smooth; leaflets ovate, obtuse, the outer one smaller.

Obs.—Stems climbing by tendrils, from one to two feet high, according to its place of growth, grooved. Leaves many-paired, terminated by a branching tendril. Leaflets ovate, obtuse, sometimes emarginate, somewhat hairy, the outer ones gradually smaller. Flowers commonly in fours, on very short pedicles, all directed one way, dark blue, purple. Legume or pod nearly erect, brown, dotted, smooth. Seeds globular, even. Native of Britain. Root perennial.

Experiments.—The produce on the sixteenth of April from a brown sandy loam, with manure, is 5,445 lbs. per acre.

The produce of latter-math is 6,806 lbs. per acre.

In the Memoirs of the Bath Agricultural Society, the Rev. G. Swayne informs us, that the bush vetch “shoots earlier in the spring than any other plant eaten by cattle; vegetates late in the autumn, and continues green all winter. But it is difficult to collect the seeds, as the pods burst and scatter them about, and, moreover, hardly a third part of them will vegetate, being made the nidus of an insect. A patch sown in drills in a garden was cut five times in the course of the second year, and produced at the rate of twenty-four tons on an acre, of green food; and when dry would weigh nearly four tons and a half.” The nutritive matter of this vetch consists almost entirely of mucilage and sugar; the bitter extractive principle which exists in the nutritive matter of the leaves of all grasses is here in a less proportion. The produce in these experiments is less than that obtained by Mr. Swayne, but the difference is to be accounted for from the different soils employed. The plant attains to a considerable height when connected with bushes, and evidently prefers shady situations. But the produce, as shown above, on a middling soil, in an exposed situation, is very

considerable; and it maintains its place when once in possession of the soil. Horses and oxen are very fond of it; I have observed them eat it closer to the ground than they did the surrounding herbage of cock's-foot, tall oat-like soft-grass, ray-grass, and cow clover. Its produce is very inferior when cultivated on a clayey soil, for which it appears unfit. The seeds vegetate readily when sown about the end of April or in the beginning of May.

It comes into flower about the middle of May, and the seed is ripe about the middle and end of June.

LOLIUM *perenne*. Rye-grass*, Perennial Darnel, Ray-grass, Perennial Rye-grass.

Specific character: Spike awnless; calyx shorter than the spikelet; florets lanceolate. *Fig.* 1. Spikelet. 2. Floret. 3. Germen and stigmas. 4. Nectary.

Obs. — The varieties of this species are very numerous: as the slender ray-grass (var. *tenue*), see our figure; the compound, or broad-spiked ray-grass (var. *compositum*); Pacey's ray-grass (var. *ramosum*); Russell's grass (*Russellianum*), see our figure; Whitworth's grass (*Whitworthiensis*); Stickney's grass (*Stickneiensis*); panicked ray-grass (*paniculatum*); double-flowered ray-grass (*monstrosum*); viviparous ray-grass (*viviparum*); and varieties of these, according to the age of the plant and the soil it grows in. The first variety (*tenue*) is common to dry pasture land that has been impoverished and worn out by injudicious cropping; it is distinguished from the other varieties by its perfectly upright spike, which is slender, and the spikelets small and distant from each other, consisting of three to five flowers; the root-leaves are very narrow and few in number; the culms are almost naked or destitute of leaves. The second variety (*compositum*) grows in a richer soil, or in soils that have been long under grass, and is there for the most part

* It should be *ray-grass*, from the French *ivraie* or *yvre*, drunken; in allusion to the noxious qualities of the larger ray-grass, or darnel (*lolium temulentum*).



Lolium Perenne

Russellianum

confined to beaten parts, as the cart-ways and sides of paths. It is distinguished by its short and broad spike, crowded with spikelets towards the top; spikelets consisting of from seven to nine florets, of a green or purplish colour; the culm is never upright, but ascending, and almost covered with the sheaths of the leaves, which are numerous. The third variety (*ramosum*) is more common in rich meadow land than in any other soil; the spike is nearly upright, spikelets shorter, glumes more pointed, and the stem furnished with long leaves: the root-leaves are numerous, and larger in every respect than any of the preceding. I believe this to be the improved, or Pacey's ray-grass: it is the most valuable of the varieties above mentioned. The panicked ray-grass exhibits a very singular though accidental deviation from the proper character of the species—that of flowers disposed in a spike. I found this variety not uncommon in the lower parts of Mr. Westcar's celebrated pastures of Creslow. The double-flowering ray-grass I found in a meadow near St. Ives, and it was raised in the Experimental Grass Garden at Woburn Abbey, from seeds communicated by Mr. Neill of Mansfield. It has the spikelets globular, which give to the spike the appearance of being composed of double flowers. The viviparous variety grows luxuriantly after Midsummer; it is strictly viviparous, never producing flowers or seed, but young plants from the glumes or ears. When supported, the ears emit plants which frequently attain to two and three inches in length. A specimen of the stoloniferous ray-grass was communicated by Mr. Whitworth, from his extensive collection at Acre House. Of late years much has been done in discovering new and improved varieties of *lolium perenne*. Mr. Whitworth has devoted much attention to this subject; and the talents, judgment, and success he has displayed in this important inquiry, deserve very great praise. His collection of the varieties of *lolium perenne*, in 1823 amounted to the surprising number of

sixty; but as many of these had been merely transplanted into his experimental ground, and not submitted to the test of reproduction by seed, their permanency, or their characters as to being permanent or only accidental varieties, had not been determined. The labours of this gentleman have been rewarded by the discovery of that valuable variety which bears his name; and further important results may be expected from his talents and perseverance. Another valuable variety has been introduced very lately into practice, by Mr. Holdich, the late able and ingenious Editor of the Farmer's Journal, which he named "the Russell ray-grass," on account of the original plant from which he raised the first stock of seed having been pointed out to Mr. Holdich by the Duke of Bedford. Mr. Stickney, a celebrated cultivator in Holderness, has likewise introduced into practice a variety, said to have great merit, and which passes under his name. There are other varieties said to be valuable in practice, sold under the names of *Dixon's* and *Ruck's* ray-grass. All the varieties have a strong tendency to vary in their form when sown on different soils. The annual species are common only to land under cultivation: they will be found under the head of "Plants adapted for the Alternate Husbandry."

On this interesting subject, the comparative value of these new varieties, I have much satisfaction in being able to quote the authority of that eminent agriculturist, Francis Blaikie, Esq.: he considers these new varieties as decided improvements on the common, and on the Pacey's ray-grass. Since writing the above, I am informed by the Rev. C. Lord, that in some parts of Berkshire an excellent variety of ray-grass is in use, under the name of church-bennet, or church bent-grass.

Root perennial, fibrous.

Experiments. — On the 16th of April, the produce of the improved Pacey's ray-grass from a rich brown loam is 4,083 lbs. per acre.

The proportional value which the grass at the time of flowering bears to that at the time the seed is ripe, is as 11 to 10; and to the grass of the latter-math, as 5 to 2.

There has often been occasion to observe, that though grass, when left till the seed be ripe, may afford a greater quantity of nutritive matter, nevertheless the value of the latter-math which is lost by this means is often greater than the extra quantity of nutritive matter thus obtained; add to this the impoverishing effects of the plants on the soil, by the process of ripening the seed, and the less palatable nature of the hay. The plants of grass are likewise much weakened by the production of seed; for in all the experiments I have made, the produce of latter-math proved always less, in many instances one-half less, in a given time after the seed crop, than after the crop taken at the time of flowering; I never could perceive, however, that the bad effects extended in any degree to the next following season, the weight of produce being then as frequently superior as equal or less.

Ray-grass appears to have been cultivated previous to the year 1677; besides which, red clover, sainfoin, spurrey, trefoil, and nonsuch, were the only plants then cultivated as grasses, or termed such. And it is only of late years that any other species of the natural grasses has been tried as a substitute for it in forming artificial pastures — as cat's-tail grass (*phleum pratense*); cock's-foot grass (*dactylis glomerata*); and fox-tail grass (*alopecurus pratensis*). The cat's-tail grass appears to have been made trial of before either of the other two, not more than fifty years ago, by Mr. Rocque, a farmer at Walham Green, near London. The seed of the cock's-foot grass was introduced about the same time from Virginia, by the Society of Arts, &c., but no trial was made of it till several years afterwards: it was then called orchard-grass; and it is but lately that the fox-tail grass has been tried on an extensive scale—the merits of which seem to have been first accurately pointed out by the late excellent Mr. Curtis, in his several works on grasses.

There has been much difference of opinion respecting the merits and comparative value of ray-grass. It produces on

abundance of seed, which is easily collected and readily vegetates on most kinds of soil, under circumstances of different management; it soon arrives at perfection, and produces in its first years of growth a good supply of early herbage, which is much liked by cattle. These merits have, no doubt, upheld it till the present day in practice, and will probably, for some time to come, continue it a favourite grass with many farmers. But the latter-math of ray-grass is very inconsiderable, and the plant impoverishes the soil in a high degree, if the culms, which are invariably left untouched by cattle, are not cut before the seed advances towards perfection. When this is neglected, the field after Midsummer exhibits only a brown surface of withered straws.

Let the produce and nutritive powers of ray-grass be compared with those of the cock's-foot grass, and it will be found inferior in the proportion nearly of 5 to 18; and also inferior to the meadow fox-tail in the proportion of 5 to 12; and inferior to the meadow fescue in the proportion of 5 to 17. In these comparisons, from which the above proportions arose, it was necessary to omit the seed crops for the truth of comparison.

But as the seed of the fox-tail is often defective, and the plants of the fescue (*festuca pratensis*) do not arrive at perfection so soon as those of ray-grass; their superiority, as above, is somewhat lessened with respect to their value as alternate husbandry grasses; for permanent pasture, however, the above proportional values will be found true, as ray-grass is but a short-lived plant, seldom continuing more than six years in possession of the soil, but is continued by its property of ripening an abundance of seed, which is but little molested by birds, and suffered to fall and vegetate among the root-leaves of the permanent pasture grasses. But cock's-foot grass perfects an abundance of seed, and the plants arrive at a productive state as soon as those of ray-grass; hence its superiority, as above, is equally great for permanent pasture and the alternate husbandry; which is not so precisely the case with the fox-tail grass and meadow fescue. One peck of ray-grass, with 14 lbs. of clover, per

acre, is generally considered sufficient for sowing artificial pastures.

The above details relate to the Pacey's variety ; and the following details will show to a certain extent the superiority of the new varieties.

1. The Russell's ray-grass. The produce on the 16th of April from a brown rich loam is 5,445 lbs. per acre ; of nutritive matter, 212 lbs. At the time of flowering the produce is 15,654 lbs. of grass per acre ; of nutritive matter, 733 lbs.

The value of this variety, it is perfectly evident, is therefore greatly superior to the Pacey's ray-grass in produce and nutritive properties ; and to these must be added its superior early growth in the spring, and its continuing to vegetate later in the autumn and winter. These properties go near to remove entirely the objections which have been so justly urged against the common ray-grass.

2. Stickney's approaches near to this in its habits and nutritive properties, but I have not had an opportunity to ascertain the produce of it, with that degree of precision and certainty which would allow of my giving the results of the trials a place here.

3. The Whitworth's is finer in the foliage than either of the above varieties. This variety seems also to possess the valuable properties of early and late growth, in an eminent degree. These varieties of ray-grass are a valuable acquisition to the farmer ; and more particularly, should those characters which now render them so valuable prove permanent, after experiencing the various trying effects of different changes of soil and situation under long cultivation. The habit of the Whitworth's indicates an origin from higher situated though rich land ; while the habits of the Russell and Stickney indicate an origin from a less elevated though equally rich land. It is more than probable that, should attention be paid to have the seeds of those grasses always supplied from their respective original soils, or from analogous soils, that the valuable properties they now possess may be perpetuated. Besides those varieties, there have been

cultivated and submitted to careful experiment in the grass-garden at Woburn Abbey, fifteen apparently distinct varieties. The greater number of these have not stood the test of reproduction from seed, but have merged into one or other of the above-mentioned varieties. Mr. Neill, of Mansfield, communicated six varieties, one of which proved identical with Stickney's grass, and another proved to be the same with the Russell ray-grass. Mr. Neill had first collected the seeds of these from rich pastures, and by afterwards cultivating them in his garden obtained seed sufficient for farm practice.

Ray-grass, when not more than three years old, flowers in the second week of June, and ripens the seed in about twenty-five days after: as the plants become older they flower much later, sometimes so late as the beginning of August.

For the following statements of the produce of the Whitworth ray-grass I am indebted to Mr. G. Whitworth. "About eighty acres of rather thin poor *wold*-land, incumbent on chalk, was sown with the Whitworth variety and clover, the former predominant. In 1819, the first season of grass, the land kept some ewes and lambs until the 1st of May, when it was shut up for mowing. The produce of hay was fifty-four good waggon-loads, but thirty acres were allowed to stand for seed, the produce of seed from two to three quarters per acre. The pasture was laid in for about four weeks, then stocked with five hundred lambs, which it kept for seven weeks, and afterwards kept one hundred and sixty lambs, with the help of a little hay given occasionally, through the winter, and until the beginning of April, when three hundred ewes and lambs were put in and did well through the spring months."

To the serious objections to ray-grass as a precursor to wheat, Mr. Whitworth says, "that his variety is so tenacious of life, that two or even three ploughings are necessary to overcome the grass, otherwise the roots of the grass will take up the nourishment of the soil, to the great injury of the wheat-crop."



Trifolium Medium

TRIFOLIUM *medium*. Marl-Clover, Cow-grass.

Specific character : Spikes loose, stems flexuose, branched ; corollas nearly equal ; stipules sublate, linear.

Obs.—The common broad-leaved red clover is distinguished from the present plant by the spike, which is loose and rather oblong, while that of the broad-leaved clover is globular and compact. The root of the marl-grass is creeping, that of the broad-leaved clover spindle-shaped and fibrous. The stem of the perennial sort is more constantly zig-zag. The leaves are also smoother and longer. There are three varieties of the broad-leaved clover (*trifolium pratense*), mentioned by botanical writers, one of which is said to be perennial and the true marl or cow-grass ; but all the seeds and plants I have had for this (except that from Messrs. Gibbs and Co., which proved to be the present plant) have turned out only two-year-lived plants, or never exceeding three, though cultivated on various soils. Since the above details were first printed, I have found the true *trifolium pratense perenne* in the rich grazing lands in the vale of Aylesbury, and also in the rich grazing lands in Lincolnshire—a figure of which is presented to the reader in the following pages. The plants of marl clover upon which the following experiments were made, were taken from a rich ancient pasture, which was so closely cropped at the time, that the plant was only three inches high, though in flower. This plant is also frequent on cold tenacious clayey soils, where it is of smaller stature, more woody, and darker coloured ; but when transplanted to a richer soil its appearance is much altered. The distinctions of the perennial and the biennial root are the most certain, and of the most importance to the agriculturist in choosing between two plants of nearly equal value for the purpose of permanent pasture. To avoid any chance of mistake, therefore, I here present a figure of the marl clover or cow-grass, which I have brought

from a rich ancient pasture that had never been under the plough, according to the oldest recollection.

Experiments.—At the time of flowering, the produce from a rich black loam is 20,418 lbs. per acre.

The produce of latter-math at two different cuttings is 19,057 per acre.

The weight of nutritive matter contained in the latter-math herbage is equal to that afforded by the flowering herbage. The plant, as it passes this stage of growth, becomes woody, particularly at the bottom of the stalks. It pushes forth flowering stems during all the summer and autumn, if never suffered to perfect its seed. It withstands the effects of severe dry weather better than most pasture plants, owing to their deeper rooting, continuing to flower even when the surrounding herbage is burnt up on strong loamy soils. The white clover (*trifolium repens*), and the hop clover (*trifolium procumbens*), are, at least so far as my observations have extended, the only plants beside that retain verdure and powers of growth under such circumstances. There were favourable opportunities, during the long continued season of dry weather in this year (1815), to observe the powers of different grasses and plants to resist the effects of drought: there were no plants on ancient pasture land, on lighter soils, or on clays, that appeared so little affected by it as those I have mentioned. The common quaking-grass (*briza media*), was to all appearance completely dried up, while on a sandy soil, a rich black loam, and a strong clayey soil, the fine bent grass (*agrostis capillaris*), and the different varieties of the stoloniferous bent-grass or florin, were, with respect to foliage, in the same state as the quaking-grass. This property, therefore, gives additional value to the perennial red clover.

On a comparison of the produce and nutritive qualities of the broad-leaved clover (*trifolium pratense*), with those of the above, the broad-leaved clover is found to be greatly superior.

The broad-leaved cultivated clover (*trifolium pratense*), at the time of flowering, affords of nutritive matter, from the produce of one acre of a clayey loam, 1,861 lbs.; from the

produce of latter-math, taken at two different times, 930 lbs.; total 2,791 lbs. per acre in one year.

The cow-grass (*trifolium medium*), as above, affords of nutritive matter, from the produce at the time of flowering, 717 lbs.; from the produce of latter-math, at two different cuttings, 670 lbs.; total 1,387 lbs. per acre in one year.

The weight of nutritive matter, in which the produce of one acre of the *trifolium pratense* (broad-leaved cultivated clover), exceeds that of the cow-grass, is 1,404 lbs. per acre in one year.

In regard to produce, therefore, the biennial-rooted clover is superior to the perennial, in the proportion nearly of 2 to 1. As a plant for the alternate husbandry, the broad-leaved cultivated clover will evidently be preferred; but for permanent pasture, the cow-clover (*trifolium medium*) must of necessity have the preference. The quantity of nutritive matter, contained in the herbage of the broad-leaved clover, is somewhat greater than in the herbage of the cow-clover, proportionally, according to my experiments, as 10 to 9. The constituent parts of the nutritive matters of the plants are nearly alike, only the broad-leaved clover contains nearly three per cent. more of the bitter extractive and saline matters than are contained in an equal weight of the cow-clover. This species, likewise, contains much less superfluous moisture than the former, and is in consequence more quickly and safely converted into hay; for it is evident, the difficulty of making good hay, is in direct proportion to the quantity of superfluous moisture any herbage may contain.

The value of the cow-clover has been disputed, but it seems probable that any doubts as to its merits, may have arisen from using it instead of the *trifolium pratense* (biennial red clover) in the alternate husbandry, for which it seems unfit, or at least greatly inferior to that species. But for permanent pasture, on soils too light for the *trifolium pratense perenne*, its value is undoubtedly considerable.

It flowers about the beginning of July, and the general crop of seed is ripe about the beginning of September. Hares

and rabbits are very fond of this clover when cultivated on a rich soil.

TRIFOLIUM *pratense perenne*. Perennial Red Clover.

Specific character.

Obs. — In the fertile grazing lands between Wainfleet and Skegness, in Lincolnshire, this true perennial red clover is abundant. An opportunity was afforded me to examine this species very satisfactorily in its natural soil, when the plants were in full blossom. The root is slightly creeping and extremely fibrous; in these points it differs essentially from the common broad-leaved clover, the roots of which are almost spindle-shaped, with comparatively few fibres. The common broad-leaved clover is of a lighter green colour, has fewer hairs on the stem and leaves, and grows more upright. The botanical discriminating characters are less obvious, indeed not sufficient to make this plant more than a permanent variety of *trifolium pratense*. The sheaths are terminated with narrower and longer points, which are set with longer hairs. The flower-stalks are in general longer and more slender, with an evident disposition to grow bent and flexuose. The heads of flowers are less crowded with florets, although apparently, to the sight, equally as large as the common cultivated clover. When young, the flower-head has the appearance of extreme wooliness or pubescence.

Last summer, when examining the rich grazing lands in Lincolnshire, I found this plant to be more prevalent than any other species of clover. In the clayey districts, and in soils of a peaty nature, this species of clover was more conspicuous than in the alluvial soils. The natural appearance of this plant, in these celebrated pastures, is such as to recommend it strongly for cultivation. It being strictly perennial, and the root only slightly creeping, it may be used for the alternate husbandry, for which the *trifolium medium* is inadmissible, on account of its creeping roots, constituting



Trifolium Pratense

what in arable lands is termed *twitch*. The seed of this valuable clover should first be collected from plants in those valuable pastures near Skegness, where it abounds: and from this, a stock of plants to increase the supply of seed for general farm practice might soon be obtained.

The nutritive powers of this species are superior to those of the *trifolium medium*, in the proportion of 10 to 9. At the time of flowering, 64 dr. of the herbage of the *trifolium pratense perenne* afforded 2 dr. 2 qr. of nutritive matter. It thrives better when combined with other grasses than when cultivated by itself; but this, indeed, is also the case with all the valuable grasses. The *trifolium medium*, the *cynosurus cristatus*, *lolium perenne*, *alopecurus pratensis*, *avena flavescens*, *hordeum pratense*, *poa trivialis*, *holcus avenaceus*, *poa pratensis*, *trifolium repens*, *holcus lanatus*, and *festuca pratensis*, were the grasses among which I found this perennial red clover to flourish, in the clayey and alluvial soils in Lincolnshire. The slightly creeping root remains permanent in the experimental garden, while the roots of the common broad-leaved clover have almost disappeared in the third season from sowing. For permanent pasture, therefore, this variety is the only proper one to cultivate, for disappointment will be found a certain follower of the broad-leaved clover, when sown with the intention of constituting a part of any permanent pasture. The figure and description will enable the farmer to decide, whether the variety of red clover he cultivates be the true perennial species. For clayey and peaty soils, and for loams, this variety is doubtless superior to the *trifolium medium* or cow-grass, and to any other variety of red clover at present known for the purposes of permanent pasture; but for soils of a drier nature and lighter texture, the *trifolium medium* offers greater advantages.

TRIFOLIUM repens. White Clover, White Trefoil, Dutch Clover.

The white or Dutch clover of the shops has been supposed an hybrid variety of the true perennial white clover of an-

cient natural pastures, and that it continues only a short time in the land when sown ; and not continuing permanent, as is the case with the white clover of natural pastures. I cannot find any facts in direct proof of this supposition. There are, doubtless, more than one variety of white clover (*trifolium repens*).

Native of Britain. Root perennial.

This species of clover is so familiar to every agriculturist, that a specific description of it in a work of this nature may be unnecessary.

The value of white clover to the farmer is well known. It is common in most, or rather, it is present in every kind of pasture land in Britain. From the circumstance of growing spontaneously in almost every kind of soil, few plants vary so much in size : in very dry and poor sandy soils it is often so small, and grows so flat among the lower leaves of the herbage, that it is not perceptible unless a turf is cut, and carefully examined by dividing it ; hence, on breaking up and manuring such soils, or simply manuring by top-dressing, a spontaneous crop of white clover appears where it was never observed before, and without any supply of seed : this has led to strange conclusions respecting the propagation of plants.

The central root of white clover penetrates to a considerable depth in the soil, and the plant is thereby better prepared to resist the bad effects of severe dry weather, particularly on sandy soils. The branches that trail on the surface send down fibrous roots from the joints, which penetrate but a little way into the ground : hence it is, that the white clover maintains itself in soils of opposite natures ; for if the surface be too dry to afford nourishment to the branches, the principal root preserves it ; and when the tenacity and retentiveness of the soil in a wet winter is great enough to rot the tap-root, the fibres of the runners preserve the plant in safety. From this habit of growth, top-dressings and a frequent use of the roller encourage the growth of this plant in an extraordinary degree. White clover, when cultivated by itself, is far from forming so good a pasture as when combined with the natural grasses ;



Agrostis Stolonifera Latifolia.

and I have witnessed the dangerous effects of pure clover pasture on sheep, by inducing disease, and at the same time the superior value of it in pastures containing a due admixture of the natural grasses; among many instances of this sort, one is selected, and mentioned in the introduction to these details of experiments.

On a comparison of the nutritive matter afforded from equal weights of the white and red clovers, it appears that the white clover is inferior.

The biennial red clover (*trifolium pratense*) affords of nutritive matter, 2 dr. 2 qr.

The perennial red clover (*trifolium pratense perenne*) affords of ditto, 2 dr. 2 qr.

The white or Dutch clover (*trifolium repens*) affords of ditto, 2 dr.

The brown five-leaved variety of white clover affords of ditto, 2 dr. 2 qr.

The white clover is therefore inferior to the biennial broad-leaved red clover in the proportion of 5 to 4; and inferior to the red perennial clover in the proportion of 10 to 9. The brown variety of white clover is equal to the biennial red clover in the quantity of nutritive matter it contains, but with respect to the quantity of herbage it is greatly inferior to the white variety, or Dutch clover.

Sir Humphry Davy has shown, that the nutritive matter of the clovers contains a greater proportion of bitter extractive and saline matters than the proper grasses; and that when pure clover hay is to be mixed as fodder, it should be with summer hay rather than after-math hay.

Within these few years, that is, since 1834, a new forage plant has been introduced into British husbandry, called *trifolium incarnatum*, or flesh-coloured clover. If sown on a wheat stubble, and harrowed in, it succeeds better than if the ground was ploughed. It rises early, and in some instances it has answered pretty well; but, like all other plants, the first trial is always the most promising.

AGROSTIS *stolonifera* (var. 1, *latifolia*). Larger-leaved Creeping Bent, Fiorin.

Specific character: Panicle loose at the time of flowering, contracted afterwards; florets large, numerous; calyx-husks acuminate, outer serrulated from the keel upwards, inner only slightly towards the top.

Obs. — This variety of creeping bent-grass being confined to the richest natural pastures, at least as far as my observations have extended, I have introduced it in this place; the specimens and details of experiments made on the other varieties which are now to be mentioned, will be found in another part of this work.

Var. 2. Smaller-leaved creeping bent (see *agrostis stolonifera*, var. *angustifolia*) is distinguished from the above by its panicle, which is densely crowded with florets, smaller, and of a whitish colour, which distinguishes it at first sight from the large spreading dingy purple panicle of the above; the leaves of which also are longer and broader, pointing more direct from the stem, and the joints more distant, and distinguished from those of every other variety of fiorin by the dull purple or brownish colour, which seems to unite them with the stem: in the *angustifolia* the colour is white or grey. This second variety I believe to be the *agrostis stolonifera* of the English Botany, 1532.

Var. 3. Awned creeping bent-grass (see *agrostis stolonifera*, var. *aristata*), is distinguished from the first variety by its larger valve of the blossom having an awn twice its length, while the same valve in the true fiorin (var. 1) has only the rudiment of an awn fixed below the apex, and which can be distinctly seen only by the aid of a glass; the panicle is also smaller; the colour of that part of the stem nearest to the joint is reddish; the joints much less swoln.

Var. 4. Wood creeping bent-grass (see *agrostis stolonifera*, var. *nemoralis*) is more like the first variety than any of the others; but the panicle is more wide-spreading, the branches rougher, the florets more pointed, smoother, the leaves narrower, and lying more flat on the ground; the creeping stems or runners are more slender, and lie quite flat on the ground, joints smaller and nearly colourless.

The marsh creeping bent-grass may be justly considered var. 5 (see *agrostis palustris*); it approaches nearest to var. 2

(*angustifolia*), but the panicle is spear-shaped, loose when in flower, and contracted so much when in seed as to resemble a spike, and is of a whitish-grey colour; it is essentially distinguished from the others by the larger valve of the blossom being furnished with a minute awn, which rises a little above its middle, and reaches to the top of the valve; the awn is straight, and pressed close to the back of the valve.

The above characters of distinction, and the figures which are afterwards given to illustrate them, were taken from plants raised from seed on the same soils that the plants were found naturally growing on, and on different soils; the characters of the wild plants were compared with those of the cultivated ones, and what remained constant after these changes of circumstances are the above. It is easy to conceive the change that takes place in the general appearance of a plant when brought out of a wet ditch and cultivated on a dry exposed soil, or from under the shade of trees on a poor sand, and planted out on a rich loam with full exposure to the sun and air. Characters, therefore, that change with these changes of circumstances, tend more to perplex than enlighten, and may therefore be better omitted.

Experiments.—At the time of flowering, the produce from an active peat soil is 17,696 lbs. per acre.

At the time the seed is ripe the produce is 19,057 lbs. per acre.

The produce of latter-math is 2,722 lbs. per acre.

The Rev. Dr. William Richardson has introduced this variety of the *agrostis stolonifera* to the agricultural world under the name of florin, and has shown its merits and properties, deduced from his own experiments, in a variety of publications on the subject, to which the reader is referred. It is greatly superior, in point of produce and nutritive powers, to the other varieties of the *agrostis stolonifera* which have been enumerated; this will be manifest on referring to the details of experiments made upon them, as given under the head of grasses natural to moist soils.

On comparing the specimens of these different varieties, their resemblance to each other is so great, that they may be easily mistaken for each other, without a close inspection, and some knowledge of botany to assist it. It was before observed, that this variety (larger creeping bent or fiorin) appears to be confined to rich ancient pasture land, as its natural place of growth, and the other varieties to various soils and situations; and that when taken from these different soils, and cultivated together under the same circumstances, they retain the discriminating characters before mentioned.

On damp clayey soils, the second variety is the most common grass. To moors and bog soils the third variety is chiefly, or (at least according to my observations) altogether confined. To light sandy soils, particularly when more or less shaded, the fourth variety is peculiar; and the fifth variety is seldom found but in the bottom of ditches, or by the sides of rivulets. The first variety being therefore scarce, and the others very common, there is little room for surprise at the contradictory results of experiments that have been made on one or other of these inferior varieties, by gentlemen equally eminent for agricultural knowledge, under the conviction of their being one and the same grass as recommended by Dr. Richardson, under the name of fiorin; whereas, though they agree in the general habit of Dr. Richardson's variety, and indeed in every respect except in the characters before described, their inferiority in every agricultural merit is so great, as to justify the opprobrious epithets that have been bestowed upon them by those, who, from the above causes, have differed from Dr. Richardson's statements of the merits of the first variety, or fiorin, and prevented that justice being done to the discovery which it may have deserved.

The above details will assist the farmer in deciding on the comparative merits of this grass, as a constituent of a mixture of grasses for permanent pasture; from which it will doubtless appear worthy of attention, but its value not so great as has been supposed, if its habits or manner of

growth be impartially taken into the account, when compared with the produce and nutritive powers of other grasses.

This grass, when cultivated by itself, cannot be profitably depastured, on account, principally, of its peculiar manner of growth, which has been compared to that of strawberries. It sends out runners or stolones, which strike root at the joints; the feet of cattle mixing part of the soil with these, render the most valuable part of the plant unfit for food. In its combined state in ancient pastures this objection is lost, as the root-leaves and consolidated turf of the various grasses prevent completely such an effect from the feet of the cattle, which will be evident on a few moments' examination of a close-eaten turf of such pastures as now described. In this state it is much less productive than when cultivated singly, as the fibrous roots of the stolones derive their only nourishment from the moisture secreted among the root-leaves of the other grasses.

The chief advantage of this grass in permanent pasture is its late growth. It remains in a degree inactive till other grasses have attained to perfection, and when their productive powers become exhausted, those of florin and its varieties begin; and it will be found, on inspection, that the latest mouthful of herbage, and sometimes the earliest in those pastures, is principally afforded by this grass.

There has been much prejudice existing against the different species of *agrostis* in general; but, let the proprietor of a rich ancient pasture divest a part of it of this grass entirely, and the value of the plant will be demonstrated in the comparative loss of late and early herbage. In these pastures, late in the autumn, I have observed the stolones extend to a considerable length, and left untouched by cattle: in the spring, however, they were generally eaten, and the protection they had afforded to the under grasses was evident in the superior early growth of the herbage, where the stolones had most extended; after this, the creeping bent was hardly to be recognized till the other grasses had again exhausted themselves, towards the end of

the autumn. The plant, in this state of combination, takes but little from the soil.

In comparing the produce and nutritive powers of different grasses, to arrive at a knowledge of their relative value, it is absolutely necessary, for the truth of comparison, that the produce of one whole season be taken, and not one crop singly, except in instances where the produce consists but of one crop only. Accordingly, the produce of fiorin may be compared with that of the cock's-foot grass (*dactylis glomerata*), meadow fescue (*festuca pratensis*), and the meadow fox-tail (*alopecurus pratensis*), when it will appear inferior to the two former species, and superior to the latter. On referring to former details it appears, that

The *agrostis stolonifera*, var. *latifolia*, larger creeping-bent, taken in December, affords of nutritive matter 1,405 lbs. per acre in one year.

The *dactylis glomerata*, cock's-foot grass, 1,728 lbs. per acre.

The *festuca pratensis*, meadow fescue, 1,719 lbs. per acre.

The *alopecurus pratensis*, meadow fox-tail, 1,216 lbs. per acre.

The cock's-foot grass, under the circumstances described, is therefore superior to the larger variety of the creeping-bent, in the proportion, nearly, of 11 to 9.

The meadow fescue (*festuca pratensis*) is also superior to fiorin, in nearly the like proportion as cock's-foot.

The meadow fox-tail-grass (*alopecurus pratensis*) is inferior to fiorin, in the proportion, nearly, of 6 to 7.

Though the quantity of nutritive matter afforded by a grass in one whole season, is the chief property by which its comparative value can be determined, yet the particular season or seasons in which it is produced, the nature of the soil on which it can be cultivated to most advantage, and the superior facilities its peculiar habits of growth afford for its propagation, as also for reaping its produce, are points which must necessarily be taken into the account by the agriculturist, according as they are influenced by local circumstances, such as the nature of the soil, and situation of his farm.

When cultivated separately for the purpose of green food or hay, florin requires to be kept perfectly clear of weeds, its couchant habit of growth affording great encouragement for the health of upright-growing plants—under this circumstance, weeds. The numerous fibrous roots that issue from the joints of the trailing shoots or stolones exhaust the surface of the soil in a considerable degree; top-dressings with manure are therefore absolutely necessary to keep up the superior productive powers of florin. Without these points being sufficiently attended to in the cultivation of this grass, disappointment will be the result.

It perfects a sufficiency of seed, which readily vegetates; and the plants, when properly encouraged by top-dressings, I have found invariably to arrive soon at perfection. When the runners or stolones are used instead of seed, the ground is much sooner clothed with the grass: when meant as a crop by itself, the planting of the shoots or stolones appears to be the best mode; but when intended as part of a mixture of other grasses, the seed will be found by experience to be the most proper.

It flowers about the second and third weeks of July, and the seed is ripe about the second and third weeks of August.

The grasses and other plants that have now been submitted to the better judgment of the reader, comprehend all the grasses and plants which the author could ever find in the *body* of the richest natural pastures, examined every month of the year, and oftener; some other species, it is true, were sometimes found on particular spots, but could not, from their local situation, be considered as naturally belonging to such: they will be mentioned hereafter.

To those who may have perused and bestowed some consideration on the foregoing details, it may be unnecessary to observe, that the facts and observations there brought forward, offer sufficient proofs, that it is not from one or two, but from a variety of different species of grasses, that the agriculturist can hope to form, in the shortest space of time, a sward equal, if not superior, to that of the richest natural pasture.

Hastiness in generalizing from a few facts only, in things pertaining to the properties and cultivation of plants, has often led to error; it seldom benefits the cause it meant to advance: every one is told this plant, or that mode of cultivation, will best suit his purpose; most make trial, and from the want of that caution which generalization in the outset destroys, the majority fails: this leads to a difference of opinion on one side; and on the other, to a contempt of that, which, when taken in its limited sense, would have produced every advantage the object was capable of affording.

The hope of discovering a single grass or mode of cultivation superior to every other, for all the purposes of the agriculturist, under every circumstance, would surely be as rational, and the discovery, when effected, as great, as those of the Philosopher's Stone and the Universal Specific.

ALOPECURUS *arundinaceus*. Reed-like Foxtail-grass.

Specific character: Root powerfully creeping; leaves spear-shaped, spike oblong, thickly crowded: husks pubescent on the back, and largely ciliate on the edges.

Obs.—The florets are larger and more linear, or of a more equal breadth throughout than those of *alopecurus pratensis*; awns sometimes altogether wanting; culm very tall in comparison to that of the common fox-tail; but the reed-like leaves of the *a. arundinaceus* distinguish it at first sight from the *a. pratensis*. I received this species, and the next following one, from my friend Mr. Taunton. Poiret mentions that it is cultivated in the Paris gardens, but its native place of growth is unknown.

The substance of the culms and leaves of this grass is coarser than that of the *alopecurus pratensis*; and the root is so powerfully creeping, as to render its introduction into arable land a matter of great caution. The produce and nutritive powers are very considerable; it is an early grass, producing culms at an early period of the spring, and continuing to vegetate vigorously through the summer and

autumn. It cannot be recommended as a constituent of permanent pasture; but as a grass to cultivate by itself, to a certain extent, for green food, or for hay, it offers advantages, in the superior produce and nutritive powers above stated. It grows stronger and attains to a greater height than the next species, but owing to the roots spreading wide, being large, and requiring a consequent greater supply of nourishment from the soil, the produce stands thinner, and proves less weighty, than the crops afforded by the *alopecurus Tauntoniensis*.

It flowers in April or early in May, and continues to produce flowering culms until the autumn.

ALOPECURUS *Tauntoniensis*. Taunton's Meadow Fox-tail-grass.

Specific character: Spike much paniced; florets oblong; calyx ciliate on the back, on the edges nearly naked; culm upright, ribbed; root slightly creeping.

Obs. — This holds a middle station between the *alopecurus pratensis* and *alopecurus arundinaceus*. The lanceolate, strong, reed-like leaves, and powerful creeping root, of the *alopecurus arundinaceus*, at first sight, when growing, distinguish it from every other species of *alopecurus*. The strongly-ribbed lower leaves of the *alopecurus Tauntoniensis*, with its slightly, though evidently creeping roots, in like manner, when growing, distinguish it from the *alopecurus pratensis* and *a. arundinaceus*. The more minute though certain proper botanical characters of distinction, are less obvious. The florets of the *alopecurus pratensis* are more dilated or are sub-ovate, those of the *a. arundinaceus* and *a. Tauntoniensis* are sub-linear; but the florets of the latter are shorter. The edges of the calyx of the *a. Tauntoniensis* are nearly naked and smooth, while in the *a. arundinaceus* the edges of the calyx are largely ciliate, and the side-ribs so prominent, as to give an angular form to the valves. The *a. Tauntoniensis* is distinguished from *a. pratensis* and *a. arundinaceus* by deep purple tints on the calyx and awns. The anthers of the *a. pratensis*

are broad and but little cloven, while those of the two former species are narrow, long, and deeply cloven; segments bent outwards.

The superior productiveness of this grass throughout the season, furnishing very early and late herbage, equal to the very best species, are properties which recommend it very highly for permanent pasture, in company with other kinds peculiarly adapted for the purpose. The roots, although only slightly creeping, yet seem to forbid any recommendation of the plant for the alternate husbandry; for permanent pasture, however, this habit is here of advantage, as securing the extension and continuance of the plant without the serious objection of impoverishing the soil by the unprofitable production underground of vegetable matter, which occurs in the growth of the powerful creeping roots of *poa pratensis*, *agropyrum repens*, *holcus mollis*, &c. Should the seed of this species prove obnoxious to the same diseases as the seed of the *alopecurus pratensis* (which I suspect will prove to be the case), this slight creeping habit of the roots will add to the comparative value of this new species, as allowing of its cultivation with more certainty of success and smaller cost, than the general defects of seed in the *alopecurus pratensis* permit in its cultivation.

It comes into flower in April or early in May, and continues to emit flowering culms until September and October.

The superiority of ancient natural pastures over those formed artificially with ray-grass and clover, was before alluded to. It will be found principally to arise from the variety of different habits and properties which exist in a numerous combination of different species of grass. From the beginning of spring, till winter, there is not a month that is not the peculiar season in which one or more grasses attain to the greatest degree of perfection. Some grasses there are that withstand the injurious effects of long-continued dry weather better than others, and *vice versâ*. Hence the comparatively never-failing supply of nutritive herbage obtained from natural pastures, which it is vain to look for in those artificially formed with one or two grasses only.

Turfs one foot in diameter, from rich ancient pasture land in Endsleigh, Devonshire, belonging to the Duke of Bedford, contained the following plants: —

1. Turf from Hurdwick ground: *Anthoxanthum odoratum*, *cynosurus cristatus*, *lolium perenne Russellianum*, *poa pratensis*, *poa trivialis*, *dactylis glomerata*, *holcus lanatus*, *festuca pratensis*, *Achillea millefolium*, *trifolium repens*, *trifolium pratense perenne*, *rumex acetosa*, *plantago lanceolata*, *hieracium pilosella*, *prunella vulgaris*.

2. Turf one foot diameter, from Endsleigh grounds: *Festuca pratensis*, *festuca duriuscula*, *alopecurus pratensis*, *dactylis glomerata*, *bromus mollis*, *poa trivialis*, *cynosurus cristatus*, *festuca rubra*, *agrostis stolonifera latifolia*, *lolium perenne Russellianum*, *lolium perenne compositum*, *holcus lanatus*, *agrostis vulgaris*, *trifolium pratense perenne* (red perennial clover), white clover, spear-leaved ribwort (*plantago lanceolata*), yarrow (*Achillea millefolium*), *hieracium pilosella*, *rumex acetosa*, *stellaria graminea*, *bellis perennis*, *anthoxanthum odoratum*. To those who are accustomed to consider as necessary one or two species of grass only, as ray-grass and clover, the fact of twenty-two different species of grasses and other plants being produced on something less than the space of a square foot of the best fattening pastures, would scarcely appear credible, unless it was thus demonstrated. The pasture of which this turf is a specimen, on an average, per acre, fattens one bullock, of from 100 to 120 stone, Smithfield weight, and winters two sheep.

400 grains of the soil consisted of —

Water of absorption.....	55 grains.
Fine sand, partly siliceous and partly aluminous.....	148
Decomposing vegetable matter	38
Oxide of iron.....	40
Carbonate of lime or chalk	0
Soluble vegetable and saline matter.....	6
Alumina, or pure matter of clay.....	34
Silex	60
Loss	19

The most remarkable circumstance in the nature of this soil is, the excessive quantity of the oxide of iron, and the total want of carbonate of lime or chalk. In a drier climate a soil of this nature would be much less fertile. Lime combined with well-prepared compost and applied as a top-dressing, must prove highly fertilizing to a soil constituted as above. In the richest fattening pastures in Lincolnshire, which I have had an opportunity of examining minutely, and which were fully equal to fattening one large ox and four or five sheep per acre, the different species of plants were equally numerous on a given space of the ground, as in those rich pastures I examined in Devonshire; but in the Lincolnshire pastures, the natural or proper grasses were in a much greater proportion, and, excepting yarrow (*Achillea millefolium*) and the clovers, there was scarcely a plant to be found out of the family of the proper grasses. The soil was a fine loam or alluvial soil; it contained no sensible quantity of carbonate of lime or chalk, and proved, on a chemical examination of its nature, to be very similar in constitution to the soil above mentioned, except that it contained fifty per cent. less oxide of iron, and that the soluble matter of the soil afforded more vegetable extract, in proportion to the saline contents, than was indicated in the soluble portion of the Devonshire soil. The results of an examination of the rich fattening pastures in the Vale of Aylesbury, particularly those of Mr. Westcar, at Creslow, were in perfect accordance with the above, and proved in the most clear and satisfactory manner the truth of the conclusions which had, *à priori*, been drawn from the results of the experiments made individually on the grasses which compose the produce of these celebrated pastures, and equally as regarded the produce and nutritive powers of the different species.

The chief properties which give value to a grass are, nutritive powers, produce, early growth, re-germinating powers, or the property of growing rapidly after being cropped, and the facilities it offers for its propagation by seed.

If one species of grass could be discovered that possessed all these properties in a superior degree to every other, the knowledge distinguishing the different species of grass with certainty, that of the soils and sub-soil best adapted to

their growth, and their natural habits, comparative value, and merits of the different plants, would then be more for curiosity than utility. But the results of these experiments have proved, that a combination of all the merits and properties which give value to a grass, is not to be found in a superior degree in any single grass. Indeed, if such were the case, it would seem singular that nature, for the same purpose, finds it necessary to employ so many.

If a selection of grasses were made with a view to early flowering only (presuming that this property constituted the chief value of a grass), it will be found, that a combination of equal proportions of sweet vernal-grass (*anthoxanthum odoratum*), sweet soft-grass (*holcus odoratus*), soft brome-grass (*bromus mollis*), annual meadow-grass (*poa annua*), and meadow fox-tail grass (*alopecurus pratensis*), will produce a crop ripe to mow in the second week of May, on a soil of the best quality, these grasses being then in flower; but the produce will be found very inferior—the nutritive matter from the whole crop being only 367 lbs.

A combination of the smooth-stalked meadow-grass (*poa pratensis*), rough-stalked meadow-grass (*poa trivialis*), hard fescue (*festuca duriuscula*), common quaking-grass (*briza media*), darnel-like fescue-grass (*festuca loliacea*), long-awned sheep's-fescue (*festuca ovina hordeiformis*), and the Welsh fescue (*festuca Cambrica*), will afford a crop ready for mowing in the first week of June. The value of a crop, consisting of equal parts of these grasses, is superior to the preceding, in the proportion nearly of 4 to 3; the nutritive matter afforded by the whole crop being 486 lbs.

A combination of equal parts of the cock's-foot grass (*dactylis glomerata*), meadow-fescue (*festuca pratensis*), tall oat-like soft-grass (*holcus avenaceus*), perennial ray-grass (*lolium perenne*), upright brome (*bromus erectus*), and field brome (*bromus arvensis*), will produce a crop fit to mow for hay in the third week of June. The value of this crop is superior to that ripe in the first week of June, in the proportion nearly of 13 to 7; the weight of nutritive matter from the produce of one acre being 844 lbs.

A combination of cat's-tail (*phleum pratense*), yellow oat

(*avena flavescens*), crested dog's-tail (*cynosurus cristatus*), woolly soft-grass (*holcus lanatus*), wood meadow-grass (*poa nemoralis*), meadow barley-grass (*hordeum pratense*), yellow vetchling (*lathyrus pratensis*), many-flowered brome-grass (*bromus multiflorus*), and the lesser variety of the meadow cat's-tail (*phleum pratense*, var. *minus*), will afford a crop ready for reaping in the second or third week of July. The weight of nutritive matter afforded by this crop, exceeds that of the preceding in the proportion nearly of 7 to 6; the quantity contained in the produce of one acre being about 1,008 lbs.

The first of these selections, though producing the earliest crop, is, nevertheless, much less valuable than any of the others; for, with the addition of the after-grass that would be produced in the extra length of time which the others require to come to maturity, the produce would still be very inferior.

A grass which produces an abundance of early foliage, and that does not put forth its flowering culms till the beginning of June, can be fed off till a late period of the spring without injury to the crop of hay; which, with a grass that pushes up its flowering culms early in the spring, cannot be practised without doing considerable injury to the hay crop. This property, therefore, of producing early foliage and flowering late, must be more particularly valuable under circumstances where a breeding flock of sheep is kept. The grasses which are more distinguished in this respect, are the cock's-foot (*dactylis glomerata*), meadow cat's-tail (*phleum pratense*), nerved meadow-grass (*poa nervata*), and the wood meadow-grass (*poa nemoralis*).

As the leaves of grasses are the most valuable part of the plant for the purposes of grazing, a view of the quantity of nutritive matter, afforded by the different species in the spring, will assist in deciding on their comparative value.

About the beginning and middle of April, 1,920 grains of the leaves of the following grasses and other plants afford of nutritive matter—

Meadow foxtail-grass (*alopecurus pratensis*) ... 96 grs.
Tall oat-like soft-grass (*holcus avenaceus*) 120

Sweet-scented vernal (<i>anthoxanthum odoratum</i>)	52 grs.
Round-panicked cock's-foot (<i>dactylis glomerata</i>)	80
Perennial ray-grass (<i>lolium perenne</i>)	70
Tall fescue (<i>festuca elatior</i>).....	94
Meadow fescue (<i>festuca pratensis</i>)	96
Crested dog's-tail (<i>cynosurus cristatus</i>)	88
Woolly soft-grass (<i>holcus lanatus</i>)	80
Creeping soft-grass (<i>holcus mollis</i>).....	90
Meadow cat's-tail (<i>phleum pratense</i>)	80
Fertile meadow-grass (<i>poa fertilis</i>).....	70
Nerved meadow-grass (<i>poa nervata</i>)	76
Smooth awnless brome-grass (<i>bromus inermis</i>)	84
Wood meadow-grass (<i>poa nemoralis</i>).....	68
Smooth fescue (<i>festuca glabra</i>)	70
Long-awned sheep's fescue (<i>festuca ovina hordeiformis</i>)	102
Darnel-like fescue (<i>festuca loliacea</i>)	110
Creeping bent or fiorin (<i>agrostis stolonifera</i> <i>Richardsonia</i>).....	42
Wood fiorin (<i>agrostis stolonifera</i> , var. <i>sylvatica</i>)	62
Yellow vetchling (<i>lathyrus pratensis</i>).....	40
Rough-stalked meadow-grass (<i>poa trivialis</i>)...	80
Broad-leaved red clover (<i>trifolium pratense</i>)...	80
White or Dutch clover (<i>trifolium repens</i>)	64
Common quaking-grass (<i>briza media</i>)	54
Greater bird's-foot trefoil (<i>lotus major</i>)	60
Long-rooted clover (<i>trifolium macrorhizum</i>) ...	76
Lucern (<i>medicago sativa</i>).....	90
Bunias (<i>bunias orientalis</i>)	100
Burnet (<i>poterium sanguisorba</i>)	100
Cow parsnip (<i>heracleum angustifolium</i>)	90

Those of the indigenous grasses, that afford the least nutritive matter from their spring leaves, are the creeping bents, common quaking-grass, and the sweet-scented vernal. The leaves that contain the most nutritive matter are those of the fox-tail, cock's-foot, tall oat-like soft-grass, meadow fescue, tall fescue, crested dog's-tail, woolly soft-grass,

creeping soft-grass, meadow cat's-tail, awnless brome-grass, darnel-like fescue, and rough-stalked meadow-grass. The perennial ray-grass ranks with those that contain the least. Of the grasses that are not indigenous, the long-awned, or barley-like sheep's fescue, the fertile, and nerved meadow-grasses, stand the highest.

The composition of the nutritive matter of the leaves of these grasses, differs chiefly in the proportions of starch or mucilage, and the bitter extractive and saline matters of which they are constituted; for gluten and sugar form but a small part of their composition, compared to that which they form in the culms or hay crop.

The bitter extractive and saline matters, are considered as assisting or modifying the functions of digestion, rather than as being truly nutritive parts of the compound. The experiments already detailed, showed that the mucilage, starch, gluten, and sugar, were retained in the body of the animal for the purposes of life, and that the bitter extractive and saline matters were voided with the woody fibre; which, combined, constituted the excrements, or those parts of the vegetable not retained in the body of the animal for the purposes of life.

Tares and white clover are very succulent plants, and their fattening powers are well known; but when cultivated singly, or without admixture of any other plants, there are several instances that have come under my own observation, where they have been, in cold moist weather in the early part of the spring, productive of the diseases termed red-water, and diarrhœa or looseness; the former in sheep fed on white clover, and the latter in cattle fed on tares. In estimating, therefore, the comparative nutritive powers of these different proportions of vegetable principles in different grasses, or other plants, proved by experience, it appears likewise necessary to ascertain their degree of succulency, or the different proportions of water and woody fibre combined in them, as it will prove the proportion which the saline matters bear to the truly nutritive, as well as to the woody or indigestible portion of the vegetable. The statements of the loss of weight which the different grasses sustain in drying, given

in the foregoing details of experiments, will assist to determine the above point in most instances. I may be permitted to illustrate this by an example :

Tares are said to be more fattening than white clover, cock's-foot grass, or meadow-fescue.

3,000 grains of the green herbage of —

	Woody or indigestible substance.	Water.	Nutritive matter.
	grs.	grs.	grs.
Common vetch, or tares (<i>vicia</i> var. <i>sativa</i>) consist of.....	557	2,250	193
White clover (<i>trifolium repens</i>).....	470	2,430	100
Cock's foot grass (<i>dactylis glomerata</i>)	1,135	1,740	125
Meadow-fescue (<i>festuca pratensis</i>)	1,260	1,590	150

Hence, 1,135 grains of the woody fibre of tares are combined with $27\frac{1}{2}$ grs. of saline matter.

The same quantity of white clover is combined with $33\frac{3}{4}$ ditto.

The same quantity of cock's-foot grass is combined with..... $37\frac{1}{2}$ ditto.

The same quantity of meadow-fescue is combined with $27\frac{1}{2}$ ditto.

The tares and white clover contain, therefore, nearly one-third more of water than the natural grasses, cock's-foot and meadow-fescue. The white clover is remarkable for the superior quantity of extractive and saline matters it affords, in proportion to the woody or indigestible matter. The excess of water or superfluous moisture, in tares, and the small proportion of extractive and saline matters they contain, must render them a less valuable food in the early part of spring, when the weather is cold and moist, than in the latter part of that season, or in summer. If some of the natural grasses were combined with the tares, it would correct this over succulency of their nature. The annual species of grass appear to be the most proper for this purpose, merely because they soonest afford a supply of herbage from the time of sowing. The field brome-grass (*bromus arvensis*), and common barley, have their nutritive matters, and the proportions of water to that of woody fibre in their substance,

more opposite to those in the composition of tares than most other grasses, and therefore promise to be the most useful.

The different species of the natural grasses, differ less from each other, in the composition of their nutritive matters, than they do in general from the different species of clover or vetch. But in all the numerous trials I have made on the nutritive matters of the proper grasses, I could never find two species perfectly agree in the proportions of mucilage, sugar, gluten, bitter extractive, and saline matters, of which their nutritive matters consisted. To detail the results of all these processes, would probably be more tedious for the agriculturist to read, than they were to the conductor of the experiments in the performance. What has just now been stated may be sufficient to show, in some measure, the degree of importance that is to be attached to the properties in question, when making a selection of the most valuable grasses for permanent pasture, or indeed for any other purpose for which they are useful. The following grasses are selected from those of which figures have been given in the foregoing pages, as being superior to all others in one or more of the valuable properties before mentioned: in nutritive qualities, early growth, produce, reproductive powers, permanency in the soil, and the facilities they offer for their propagation by seed.

The proportions in which the seeds of the different species should be mixed for permanent pasture:—

Cock's-foot grass (<i>dactylis glomerata</i>).....	2 bushels.
Meadow-fescue (<i>festuca pratensis</i>)	2
Meadow foxtail-grass (<i>alopecurus pratensis</i>)	2
Rough-stalked meadow-grass (<i>poa trivialis</i>)	2
Tall oat-like soft-grass (<i>holcus avenaceus</i>)	0½
Meadow cat's-tail (<i>phleum pratense</i>).....	15 lbs.
Hard, or smooth fescue (<i>festuca duriuscula</i> , vel <i>glabra</i>)	2 bushels.
Crested dog's-tail (<i>cynosurus cristatus</i>)	1
Nerved meadow-grass (<i>poa nervata</i>).....	0½
Wood meadow-grass (<i>poa nemoralis</i>).....	1

Narrow-leaved meadow-grass (<i>poa angustifolia</i>)	0 $\frac{1}{4}$ bushel.
Broad-leaved creeping bent, or fiorin (<i>agrostis stolonifera</i> , var. <i>latifolia</i>)	0 $\frac{1}{2}$
Ray-grass (<i>lolium perenne</i>)	1
White or Dutch clover (<i>trifolium repens</i>)	15 lbs.
Bush vetch (<i>vicia sepium</i>)	0 $\frac{1}{2}$ bushel.
Sweet-scented vernal-grass (<i>anthoxanthum odoratum</i>)	0 $\frac{1}{4}$
Perennial red clover (<i>trifolium pratense perenne</i>)	12 lbs.
<i>Achillea millefolium</i> , yarrow	4

The proper quantity of grass seeds to sow, per acre, is a point of the greatest importance, as regards the expense of the seed, and the speedy formation of the most valuable sward. The circumstances of soil, tilth, and weather, at the time of sowing, all influence in a great degree the successful vegetation of the seed. Should less seed be sown than is sufficient to furnish every part of the soil with plants of grass, a proportionate loss of time, labour, and land, will be suffered. Minute vacancies of plants in a recently-made pasture, or in a field of seedling grasses, may, to general observation, appear insignificant, or escape observation altogether; but if these apparently minute deficiencies which occur over the surface of an acre be calculated, a difference, perhaps, of from ten to fifteen per cent. in the produce will be found to exist between a perfectly furnished surface of land, and one where the deficiencies of plants are so minute as scarcely to be perceived. In the most productive natural pastures no deficiencies of plants are to be found, every part of the surface is closely interwoven with plants; and not as in pastures artificially formed of one or two species of grass only, where the surface is merely shaded or covered by the foliage of the comparatively thinly-growing plants. A rough uneven surface will require a much greater quantity of seed, than land with a dry, finely-pulverized, smooth, consolidated surface. If the surface be wet at the time of sowing, a greater quantity of seed will be required than otherwise would be necessary. The seeds of most of the essential permanent pasture grasses are so small and light, as to be rea-

dily taken up in clumps by the harrow or roller passing over a damp surface.

From the above facts it will be evident, that the smaller the number of different species of grasses that are combined together in a pasture, the greater is the deficiency of plants on any given space of the land. This is an important fact to be considered, in coming to a just conclusion respecting the proper quantity of grass seeds which should be sown on a given space of the ground, so as to furnish the surface of it at once with the just sufficiency of plants. When an excess of grass seeds is sown, the seeds, in general, all vegetate, but the plants make little if any progress, until, from the want of nourishment to the roots, and the confined space for the growth of the foliage, a certain number decay, and give the requisite room to the proper number of plants; and that will be according as there are a greater or less variety of different species of grasses combined in the sward.

If the seeds of the before named-grasses and plants be mixed in the different proportions before stated, one bushel of such mixture of seeds, sown on an acre of land, will (omitting fractions) afford but two seeds to every square inch—while the most productive ancient natural pasture examined, had seven plants to every square inch. But the statements respecting the seeds are founded, it is evident, on the supposition that every seed vegetates and produces a plant, and that the seeds are all equally spread over the surface: but, as before observed, there are more circumstances than one which interfere to prevent the successful vegetation and equal distribution of all the fine seeds of grasses individually considered, and which may be sown at any one time. The seed of cock's-foot is often defective, the perennial red clover has frequently many abortive seeds, and the meadow-foxtail seed is generally so bad as to afford but one fertile seed out of three: to obtain a required number of plants on a given space of ground, from a known quantity of seed, a pretty large allowance must therefore be made to the seed, in order to meet those circumstances adverse to certain vegetation in every instance, and equal distribution of the plants.

The results of Mr. Taunton's valuable experiments on the cultivation of separate grasses, and the interesting remarks of Mr. Blaikie on the same subject, are in perfect confirmation of the above statements, respecting the quantity of seed to be used in cases where only one or two species of grass are cultivated. Four bushels and a half of the above mixture of grasses will give (omitting fractions) the same number of seeds to the square inch, as the like space of the sward of the irrigated meadow contained plants, namely twelve: now, after deducting for the deficiency caused by the number of barren seeds in many of those grasses, this quantity of four and a half bushels per acre of this mixture of different seeds, will be found for general practice not too much. The practical trial before mentioned, proved precisely the truth of the above calculations. But should the proportions of the different kinds of seed be altered from the above, the quantity of seed required for a given space of ground will be less in proportion as the fertile-seeded grasses predominate in the mixture: and the smaller the number of different species that are combined together, the smaller will be the quantity of seed per acre required, ten pecks being the *maximum*, and two pecks the *minimum*. The above calculations of the number and weight of the different seeds, will afford a ready guide to determine the number of plants of grasses which will be produced on a given space of ground, from a known weight or measure of the seed, whether it be of one species of grass only, or of a combination of many species.

The larger seeds should be mixed by themselves, and, in the same manner, the smaller seeds should be mixed together, and sown after the mixture of larger seeds, as they require much less covering. The separation of the larger from the smaller grass seeds, when mixed, can be readily effected by a proper sieve.

I have sown the seeds of the same grasses in every month of the year, January excepted: and though much depends on the weather and the state of the ground, the results were always in favour of the month of September and the beginning of August; and, next to that, the middle or latter end of May, according as the weather was dry. The seeds vege-

tated, and grew with most vigour under the following circumstances ; when the ground had been deeply stirred, broken very fine, and made perfectly smooth and compact on the surface with a heavy roller, previous to sowing the seeds, the ground in a dry state at the time of sowing, the seeds sown on this fine, dry, compact surface : the larger seeds not more than just covered, by drawing a fine rake on the level surface, and afterwards sowing the small seeds, and covering them no further than what was effected by a repetition of the roller. The results further showed, that, next to a coarse, in consolidated, or loose surface, the practice of deep sowing was, in the second degree, more injurious to the vegetation of the seeds and the first progress of the plants, than any other error that could be made in the *manual* part of the process of sowing the natural grasses on a soil of good quality.

When land is to be sown for permanent pasture, no admixture of any annual or grain crop, or broad-leaved clover, should be admitted with the grass seeds. Experience proves that they are highly injurious to the intention of speedily forming a solid productive sward ; and that the profit that may accrue from a grain crop thus obtained, will be much overbalanced by the loss of grass in the two following seasons. Every plant of these annual crops occupies a place, to the detriment of the expected sward ; besides rendering the surface porous by the decay of their roots in the end of autumn, much mischief, likewise, is done to the sward by portions of the crops being beat down with heavy rains. The above mixture should be sown in the autumn or spring, at the rate of four bushels and a half to the acre ; much less will form a good pasture, but when the seeds can be had from the farm at a moderate expense, the maximum quantity should be adopted. If sown in spring, it will be found highly useful, in the following autumn, to give the surface a slight top-dressing with rotten dung or compost, in which the seeds or roots of weeds are not suspected, and to sow immediately after half a bushel, more or less, of the mixture of seeds, according as the sward appears to be deficient of plants ; after which (the top-dressing being previously well reduced

by a slight bush harrow), the roller should be liberally used; and *rolling*, for the first two years, should never be neglected at any favourable opportunity. If the seeds are sown in autumn, the top-dressing, re-sowing, and rolling, will be found equally requisite and beneficial in the following month of May; and even if repeated in the following autumn, they will greatly forward the intention. This is imitating the process of nature in forming pastures—with this advantage, that for one seed of a valuable species of grass supplied to the soil by the slow and gradual process of nature, in one season, a thousand are supplied in the same space of time; and thus take possession of their natural soil, without the danger and inconvenience of expelling its usurpers.

There has been some difference of opinion respecting the manner of reaping the produce of seedling grasses; whether by depasturing with sheep, or by mowing after the plants have perfected their seed. The manure supplied by sheep to the young grasses is of great advantage; but the animals are apt to bite too close to the root, and sometimes tear up the young plants altogether. I have found, on repeated trials, that cropping seedling grasses before they had produced flowers, had the effect of retarding and weakening the after-growth of the plants for that season very much. But after the period of flowering, cropping was found to strengthen, and rather encourage the growth of plants. In the same way I found, that old plants of grass, when cut very close after the first shoots of the spring made their appearance, afforded about one-third less weight of produce in the whole season than those plants of the same species which were left uncut till the flowering culms began to appear. As the advantages of the manure of the sheep may be supplied by top-dressing, and the disadvantages resulting to the tender seedling plants from early and close cropping cannot so speedily be removed, the practice of suffering the grasses to produce flowers before they are cut, with the application of top-dressings, and the use of the roller, till the spring of the second year, appears to be far more profitable than the former practice of depasturing the seedling grasses at an earlier period than the spring of the second year. But in

this, no doubt, as well as in other particular modes of management recommended for general practice in the culture of plants, local circumstances may interfere so much as often to render some modification of them necessary.

For the following valuable observations on the mode of managing grass lands in Devonshire, I am indebted to A. Wilson, Esq. of Hurdwick House, near Tavistock. The Devonshire farmers are very expert at preparing composts for their grass lands. Compost of lime and mould :—The mould by the side of the fence within the enclosure is broken up with a plough, to the width of from three to six feet, varying according to the depth and quality of soil. With a mattock or broad hoe, the turf and mould broken by the plough are finely pulverized. After laying a few weeks, to become mellow, the soil is banked up to the depth of a foot, giving it a level surface. The lime is taken from the kiln in *clot*, and carted on the bank of mould on which it is spread. The lime is applied in the proportion of one to six; or one cart-load of lime (ten Winchester bushels) to six cart-loads of the pulverized mould. The mould on the outside of the heap is thrown over the lime to keep off the wet, until a favourite opportunity for incorporating the whole mass offers, which is as soon as the lime is reduced to a state of powder, and is effected by breaking down and turning over the bed of mould and lime. It is then banked up, with a sloping ridge to throw off the wet, in which state it remains from one to three or more months. It is carted on the land at the rate of from fifty to eighty bushels of lime per acre, or in the state of compost, from thirty to forty cart-loads per acre. This dressing is applied at different times of the year; but it has been found to answer best in May; the grass at that season springs quickly through the dressing, and gradually settles into the ground, without being injured by exposure to frost, snow, or rain. When dung is added to the compost, it is at the rate of eight or twelve cart-loads per acre; it is mixed with the compost of lime and mould two months after the latter has been made up, and in this state remains for a month: the compost is then turned over and thoroughly mixed a second time: it ought to remain, after this last

turning over, one month more before it is carted on the land. A bush-harrow is applied, a week or two after the dressing has been spread over the surface. The quality of the soil of the grass lands now spoken of, is chiefly a deep brown loam, of a very open texture; it cannot bear drought, and requires to be often dressed. In the course of ten or twelve years the dressing wears out, although the land has been during that time constantly depastured. Where the soil is of a closer texture than that now mentioned, the droppings of the stock are found sufficient to keep up the fertility of the pasture. For the first five or six years after dressing grass lands in this part of Devon, the herbage is remarkably luxuriant and succulent. The best permanent grass lands here are found incumbent on freestone.

But though the pasture be formed in the best manner, with a combination of the most valuable grasses, nevertheless, a judicious mode of treatment afterwards is as essentially necessary to continue its value. By proper stocking, top-dressing, and weeding, very indifferent pastures (where the soil was adapted to the growth of grass) have been brought to a state equal to the most valuable; and, on the contrary, the richest natural pastures, by neglect of proper stocking, top-dressing, and weeding, or the too frequent repetition of hay crops, have become so unprofitable, as to require many years to bring them again to their original value. I have witnessed in Lincolnshire soils of a similar nature in every respect, indeed a fence only separating them, exhibit the effects of judicious and of bad treatment as regards the frequent repetition of hay crops on the same field. On one side of the fence, where judicious stocking had been practised, the superior grasses wholly occupied the field, nor could I observe an inferior plant in the herbage of it, much less absolute weeds; but on the other side of the fence, where the field had been mown for a succession of years, the superior grasses had given place to the cow-parsnip (*heracleum sphondylium*), cow's-allheal (*stachys palustris*), knap-weed (*centaurea nigra*); and among these weeds were thinly scattered the (*holcus avenaceus*) tall oat-like soft grass, *dactylis glomerata*, and *agrostis vulgaris*. The neglect

of foul hedges and road-sides is the best possible encouragement for the propagation of those perennial weeds which infest permanent pasture land. In Warwickshire, I have seen valuable pasture land so deteriorated by the intermixture of these weeds, supplied liberally from foul hedge-rows and road-sides, as to be little superior to the worst land kept under proper management; besides, the weeds in these nurseries afford shelter, and, at particular periods, nourishment to insects which annoy and distress cattle in summer.

The comparative value of permanent pasture and tillage land, is a subject out of the reach of the humble narrator of facts. Yet, after all, pasture land and tillage land are so mutually dependent on each other, and the community on them both, that the question which of the two is the most valuable, and to be encouraged in preference to the other, for private or for public advantage, can never receive an absolute answer; for the various local circumstances of soil and climate under which lands may be situated, also the fluctuations in the demand for particular farm produce caused by every temporary change in the political state of the country, make it impossible to obtain data on which to ground a clear and satisfactory answer to the question, and which shall be found to be correct under every circumstance. One thing is certain, *i. e.* that pasture land is the first foundation of the riches of a farm.

All that has been here brought forward goes no further than to prove, that where such lands have already been converted to tillage, they may, by the means now recommended, be brought to as valuable a state of pasture as before, if not to a superior state, and that in the space of four years. The means for effecting this, however, have not yet been sufficiently within the power of the agriculturist. It is required that a more general knowledge of the different grasses, and of the importance, or rather absolute necessity, of a combination of *many* different grasses, instead of two or three different species, to form permanent pasture, in a short space of time, equal to the best formed by nature, shall be generally diffused among practical farmers; and also that the mode shall be adopted of raising and obtaining

the seeds of the valuable and permanent pasture grasses, from the farmer's own farm. The manner of obtaining an unfailing supply of the seeds of the permanent pasture grasses, at a trifling expense, from the farmer's own farm, was before mentioned, but I may be permitted to revert again to a subject so important. By the help of the figures, and the botanical discriminating characters of the different species of grasses given in this work, the farmer may soon furnish himself, from his best grass land, with the seeds of most of the essential grasses, at least in sufficient quantity to form a first plantation. Those species of grasses which are not on his own farm, the seedsman, or a neighbour, may readily supply, in quantity sufficient for the same purpose. These seeds being obtained, a piece of good rich land should be selected, of a nature intermediate as to moisture and dryness. It may be quite unnecessary to observe, that this soil must be perfectly clean, free from all kinds of root-weeds and seed of annual weeds. The surface or tilth cannot be made too fine, level, and consolidated, to receive the seeds. The middle of May or the beginning of June are favourable seasons for sowing the seed; but should a naked summer fallow be required, in order to bring the land to the necessary state of tilth and cleanness now mentioned, the beginning of August, or from that time until the beginning of September, will be found favourable seasons for sowing. The ground thus prepared should be divided into three parts, to correspond to the three different combinations of the essential grasses; which combinations were shown to ripen their seeds respectively at three different periods of the season. The seeds of the different species recommended above should be mixed in the proportions stated, and each of the three combinations, or mixtures of seed, sown on the division of ground set apart for it. The seeds may either be sown broad-cast or in drills; whichever mode will deposit the seed in the most regular manner is the best, for the clean state of the tilth will render weeding the first year unnecessary, and the combination or mixture of different species of the superior grasses will afterwards so fully occupy the land as to prevent the intrusion of weeds

or of less valuable plants. The seeds of clover, yarrow, and of the bush vetch, can be had from the seedsman. As soon as the plants of grasses have come up, the surface of the land should be occasionally rolled, as the plants thereby sooner establish themselves firmly in the ground, and make more vigorous and rapid growth than when the surface is less firm and consolidated. In the end of autumn, or early in the spring, a top-dressing of rotten dung, or finely-pulverized compost, should be applied to the seedling grasses, in such a manner as to prevent the necessity of bush-harrowing for the first year; a handy workman with a shovel can spread the compost regularly and finely among the plants. The use of the roller should not be neglected, on every favourable opportunity of dry weather. As soon as the seeds are ripe, which may be known by passing a spike or panicle between the fingers, advantage should be taken of favourable weather to mow the grass, laying it in thin swaths, and carefully turning it as often as necessary until the crop is sufficiently dry to thresh out; which operation must be effected as soon as possible, either on the spot or in the barn, as the circumstances of weather and convenience may appear to the intelligent farmer most to require.

By the ordinary practice of returning such soils to permanent pasture, disappointment is sure to follow; and to attempt to form a valuable permanent sward on soils not adapted to the growth of these grasses, were equally unwise; though, if the subsoil be favourable, the land may be so much improved, at a moderate expense, by the means recommended, as to fit it for the growth of the best grasses.

I have witnessed the results of several experiments on different grasses, on a large scale, conducted by Mr. Wilson on the farms of the Duke of Bedford, at Woburn. In one instance, a field containing twenty-five acres of old pasture land, where it was desirable to change the quality of the grass, was converted into tillage for eight years: the crops of grain during that time were most luxuriant. The following grass seeds were then sown: meadow fox-tail (*alopecurus pratensis*), rough-stalked meadow-grass (*poa tri-*

vialis), meadow fescue (*festuca pratensis*), tall oat-like soft-grass (*holcus avenaceus*), cock's-foot (*dactylis glomerata*), meadow cat's-tail (*phleum pratense*), ray-grass (*lolium perenne*), cow-grass or red clover (*trifolium medium*), and white or Dutch clover (*trifolium repens*). It is now the third year, and the sward is much improved, and superior in the quantity of produce to that of the original pasture. This, and several other experiments on rather a smaller scale, conducted with much care and impartiality by Mr. Wilson, have given results the most satisfactory ; proving, as far as they go, the truth of the conclusions that had been drawn from the results of the experiments detailed in the foregoing pages.

Since the above was first printed, this pasture has fully supported the character then given of it. Here the advantages of eight years' heavy annual crops, and a pasture highly improved, are the results of this trial ; and which would have been even more valuable, had not the want, at the time, of a greater variety of the seeds of the different species of the superior grasses, prevented the full complement of the essential grasses being sown.

CHAPTER III.

OF THE DIFFERENT GRASSES, AND OTHER PLANTS, WHICH ARE
NATURAL TO DRY, SANDY, AND ELEVATED SOILS.

THE former class of grasses was distinguished by their superior size, the greater succulency of every part of their structure, and by their broad green leaves — all indicating the fertile nature and sheltered situation of the soil that produces them; and the following grasses are distinguished from these by their dwarfish size, and the wiry appearance of every part of their structure, which sufficiently denote the poverty of their natural soil.

Sheep's-fescue (*festuca ovina*), viviparous-fescue (*festuca vivipara*), purple-fescue (*festuca rubra*), pubescent-fescue (*festuca dumetorum*), glaucous-fescue (*festuca glauca*), wall-fescue (*festuca myurus*), wall-barley (*hordeum murinum*), fine-bent (*agrostis vulgaris*), brown-bent (*agrostis canina*), lobed-bent (*agrostis lobata*), rock-bent (*trichodium rupestre*), snowy-bent (*trichodium niveum*), purple-bent (*trichodium caninum*, var. *muticum*, which see under the head of grasses natural to wet soils), tufted-leaved bent (*agrostis fascicularis*), waved hair-grass (*aira flexuosa*), feather-grass (*stipa pennata*), slender foxtail (*alopecurus agrestis*), hairy oat-grass (*avena pubescens*), blue melic-grass (*melica cærulea*), upright mat-grass (*nardus stricta*), blood-coloured panic-grass (*panicum sanguinale*), green panic-grass (*panicum viride*), barren brome-grass (*bromus sterilis*), crested brome-grass (*bromus cristatus*), upright annual brome-grass (*bromus diandrus*), nodding brome-grass (*bromus tectorum*), alpine meadow-grass (*poa alpina*), alpine foxtail (*alopecurus alpinus*), blue moor-grass (*sesleria cærulea*), crested hair-grass (*aira cristata*), paniced cat's-tail grass (*phleum paniculatum*),

reflexed meadow-grass (*poa retroflexa*), flat-stalked meadow-grass (*poa compressa*), upright flat-stalked meadow-grass (*poa compressa*, var. *erecta*), meadow-barley (*hordeum pratense*), bird's-foot clover (*lotus corniculatus*), larger bird's-foot clover (*lotus major*), trefoil, or nonsuch (*medicago lupulina*); to which may be added, *hedysarum onobrychis* (sainfoin). The following, belonging to this class of grasses, have already been brought under observation : — Soft brome-grass (*bromus mollis*), creeping soft-grass (*holcus mollis*), and white or Dutch clover (*trifolium repens*).

Dry, elevated situations, sandy heaths, and chalk lands, where the above grasses constitute the principal natural herbage, are less capable of being rendered fit for the production of superior grasses than peat-bogs, or waste lands that lie under circumstances favourable to irrigation. The latter only require proper draining, paring, and burning, and the application of hot manure, as lime and sand, to fit them for the production of the best grasses, the staple or constitution of such soils being so rich and good. But dry sandy soils require more labour and expense to bring them near to an equivalent state of productiveness, which can only be effected by the application of large quantities of clay, and by mixing it minutely with the soil. But though poor hungry sandy soils cannot, economically, be improved in such a degree as to fit them for the production of the superior grasses, like peat-soils, which in their natural or unimproved state are even less valuable than the poor sandy soils; nevertheless, there is sufficient evidence from practice, to prove that such soils may be converted to tillage for some years, and returned again to grass in a highly improved state, yielding a produce of double the value of that they originally afforded. I have witnessed improvements to this degree, on such soils in the farms of the Duke of Bedford, at Woburn. In the fourth volume of Communications to the Board of Agriculture, there is a variety of evidence to the same effect. If it should appear, however, from the results of the experiments here made on the grasses natural to these soils, of which an account will be found in the following pages, that the kinds of grasses employed in the im-

provements now alluded to, were not the best fitted for the soils in question, it will follow that such improvements may be greatly extended, by adopting those grasses best fitted for the soil, and that without any additional trouble or expense.

FESTUCA ovina. Sheep's Fescue.

Specific character: Panicle unilateral, rather close; florets cylindrical, pointed or awned, smooth at the base and at the edges of the inner valve; stem square; leaves folded, bristle-shaped; stipula short and obtuse.

Native of Britain. Root fibrous. Perennial.

Experiments. — At the time of flowering, the produce from a light sandy soil is 5,445 lbs. per acre.

When cultivated on a heath soil, the produce was somewhat less than the above, but from a rich sandy loam, the produce afforded was greater than from the light sandy soil; but, as the superior pasture grasses thrive well on this last-mentioned soil, and afford a produce superior to that of the sheep's-fescue on the same soil, as 3 to 1, its comparative value may be considered only with regard to its natural soil, and the grasses it produces. The smallness of the produce renders it entirely unfit for hay, and the dry weight was in consequence not ascertained.

When its produce and nutritive powers are compared with those of the purple fescue (*festuca rubra*), on the same soil, its inferiority is great.

The comparative degree of nourishment which the grass of the *festuca rubra* affords at the time of ripening the seed, and the latter-math, exceeds that of the *festuca ovina* at the same stages of growth, in the proportion of nearly 14 to 11; and exceeds the *f. ovina*, in regard to the total produce of the season, in the proportion nearly of 11 to 7.

From the trial that has here been detailed, the sheep's fescue does not prove to possess the nutritive powers generally ascribed to it. It has the advantage of a fine foliage, which is succulent, and may therefore, very probably, be better adapted to the masticating organs of sheep than

the larger grasses, whose nutritive powers are shown to be greater. Hence, on situations where it naturally grows, and as pasture for sheep, it may possibly be inferior to none on the same soil in the like state of nature. It flowers in the third week of June, and the seed is ripe about the last of July.

FESTUCA vivipara. Viviparous Fescue-grass.

Specific character : Panicle unilateral, rather close ; florets compressed, keeled, awnless, somewhat downy, as well as the edges of their inner valve and the calyx ; stem square ; leaves folded, bristle-shaped, smooth.

Obs.—I have cultivated this grass on a variety of soils, and it has always continued to produce plants instead of seeds on them all. I never could obtain a floret with either stamen or pistil. The gemma, or rudiment of the future plant (which here occupies the place of the germen of a perfect flower), in its first stage appears like a minute globule of water, visible only with the microscope ; after the spike is developed it gradually assumes an oblong figure, becomes pointed, and at last puts forth a single leaf, after the manner of the perfect seed of grasses ; other leaves succeed to this, till the weight of these, now a perfect plant of grass, except the root, forces it to fall from the spike on the ground, where it soon strikes root. This is a curious exception to the general law of nature, in the propagation of plants by their seed. Here is a plant, which has every part of a flower except the two essential parts, stamens and pistils, for its propagation, and for its admission into this class of the system of Linnæus. Yet from this imperfect flower it produces perfect plants. A great number of other grasses are viviparous, as *alopecurus pratensis*, *cynosurus cristatus*, *poa alpina*, *phleum pratense*, *anthoxanthum odoratum*, &c. &c. ; but in these the seed is first perfected, and merely vegetates in the husk from accidental circumstances, as growing in shaded

places, and from long continuance of moist warm weather. [Many of the other grasses, and even the cereals, are in the same way liable to sprout in damp weather before they are cut.—Ed.]

Experiments. — At the time of flowering, or when the spike is perfectly developed, the produce from a light sandy soil is 6,806 lbs. per acre.

This grass can only be propagated by parting the roots, or by planting the young plants formed in the ear. This might easily be effected by either means, were the grass of sufficient value to be cultivated; but from the trials that have been made of it here, it appears to have no excellence that can recommend it to the notice of the agriculturist. It is natural to alpine situations.

FESTUCA rubra. Creeping Fescue, Purple Fescue.

Specific character: Panicle spreading; florets with long awns; root creeping.

Native of Britain. Perennial.

Experiments. — At the time of flowering, the produce from a light sandy soil is 10,209 lbs. per acre.

The produce of latter-math is 3,403 lbs. per acre.

The above details may be sufficient to show that the creeping fescue has no superior merit over those species it resembles in habits, to compensate for the impoverishing effects of its creeping roots to the soil.

I found this species, last summer, growing in the sands, within high-water mark, on the coast near Skegness; the roots penetrated deeply into the loose sand, and the culms, in some instances, were nearly two feet high. Plants brought from these sands were planted in the grass-garden, where they grew not more luxuriantly, although planted in heath soil; but the colour of the foliage appeared more healthy, being of a deeper green colour.

Flowers in the third week of June, and ripens the seed in the second week of July.

FESTUCA *dumetorum*. Pubescent Wood-fescue.

Specific character: Panicle branches pointing in many directions ; spikelets pubescent ; leaves thread-shaped.

Obs.—Spikelets straddling, some pointing upwards, some slanting, some nearly horizontal. The whole plant is of a light glaucous colour, the spikelets nearly white with the numerous fine hairs that clothe them. Native of Britain. Root perennial, slightly creeping.

Experiments.—At the time of flowering, the produce from a rich black, sandy soil, incumbent on clay, is 10,890 lbs. per acre.

The produce of latter-math is 4,083 lbs. per acre.

Flowers about the second week of June, and the seed is ripe about the second and third week of July.

FESTUCA *glauca*. Glaucous Fescue-grass.

Specific character: Panicle rather spreading ; spikelets spear-shaped, awned ; culms and leaves smooth. Whole plant glaucous.

Obs.—Mr. Curtis, in his enumeration of British grasses, mentions this as indigenous ; and on this authority it is here entered, as I never could find it in its natural state. There is a variety of this species with subulate leaves, which grow in dense tufts ; every part of the plant is smaller than the first variety, and from a difference in the shade of colour, may be called var. *glaucescens*. Native of Britain. Root perennial, fibrous.

Experiments.—At the time of flowering, the produce from a brown loam is 9,528 lbs. per acre.

The produce of the latter-math is 4,764 lbs. per acre.

The *festuca glauca* is a native of alpine situations, but thrives better when cultivated on lower ground than most other species having the same origin. Its merits, however, though they do not appear sufficiently great to entitle it to the first place among the superior grasses for light soils, yet its hardy

nature, and property of forming a thick turf, as well as being nutritive, prevent it from being rejected altogether as of no value.

Flowers in the second week of June, and the seed is ripe about the first week of July.

FESTUCA myurus. Wall-fescue, Capon's-tail Grass.

Specific character: Panicle drooping, elongated, rather close; florets tapering, shorter than their awns, rough at the top; leaves awl-shaped; stem leafy to the very summit.

Obs.—Root annual. The flowers have only one stamen, which distinguishes it from all other species of fescue. It has great affinity to the *festuca bromoides*. The inner valve of the blossom is fringed towards the top; the awns are longer than those of the *festuca bromoides*. Native of Britain.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil is 9,528 lbs. per acre.

The weight lost by the produce of one acre in drying is 6,670 lbs.

64 dr. of grass afford of nutritive matter 1 dr. 2 qr.

This grass is found on walls and dry barren places. As soon as the seeds are ripe they fall out of the husks, and vegetate quickly after without any covering of earth; the plants are of the finest green colour, which they retain during the winter. This circumstance seems to have led some to suppose it a biennial or two-year-lived plant. The seeds being numerous, the young plants form a turf of the most beautiful dark green colour; in this respect surpassing every other grass. As soon as the weather is sufficiently warm in the spring for the growth of grasses in general, this property declines, and before the period of coming into flower, it is invariably attacked with the rust disease: which renders its produce of little value, were it even afforded in sufficient quantity to induce its propagation.

In attempts to eradicate these unprofitable annual grasses

from pastures, by mowing them before they perfect their seed (to which only they owe their continuance of existence), it is absolutely necessary that the mowing should be often repeated during the season, otherwise the intention will be completely frustrated.

It flowers the first week of July, and the seed is ripe about the last of the same month. Birds appear to be very fond of the seed.

HORDEUM murinum. Wall Barley-grass, Way-bennet.
Mouse Barley.

Specific character : Lateral florets barren ; calyx valves of the intermediate one lanceolate, fringed.

Obs.—Root fibrous, annual, supporting a number of culms ; culm from half a foot to a foot and a half high, procumbent at the base, afterwards erect ; spike-stalk brittle, flexuose, compressed, rough on the margin ; flowers placed in two rows, imbricated, roundish, intermediate flower nearly sitting, bisexual ; lateral florets unisexual, or neuter.

Experiments.—At the time of flowering, the produce from a clayey loam is 12,251 lbs. per acre.

The produce of this annual, at the time the seed is ripe, contains more nutritive matter than at the time of flowering ; this is a contrary result to all others of the annual grasses ; but it is, I believe, chiefly owing to a part of the seed having been left on the spikes, while in all other instances it was separated from the grass previous to its being submitted to experiment.

The above details prove this to be one of the most inferior grasses with respect to nutritive powers. The long awns with which it is armed must make it dangerous to the mouths of horses when it enters into the composition of their hay. Fortunately, it is uncommon in pastures, but chiefly confined to road-sides, and other beaten or barren places. I never could observe this grass eaten by cattle of any description, not even by the half-starved animals which feed by road-sides, where this is often the most prevalent grass.

It flowers about the first week of July, and the seed is ripe about the end of the same month.

AGROSTIS vulgaris mutica. Common Bent, Fine Bent-grass.

Agrostis arenaria, agrostis capillaris, Hudson. *Agrostis vulgaris*.

Specific character: Panicle spreading, with divaricated capillary branches; calyx valves nearly equal; stem erect; stipula abrupt, very short.

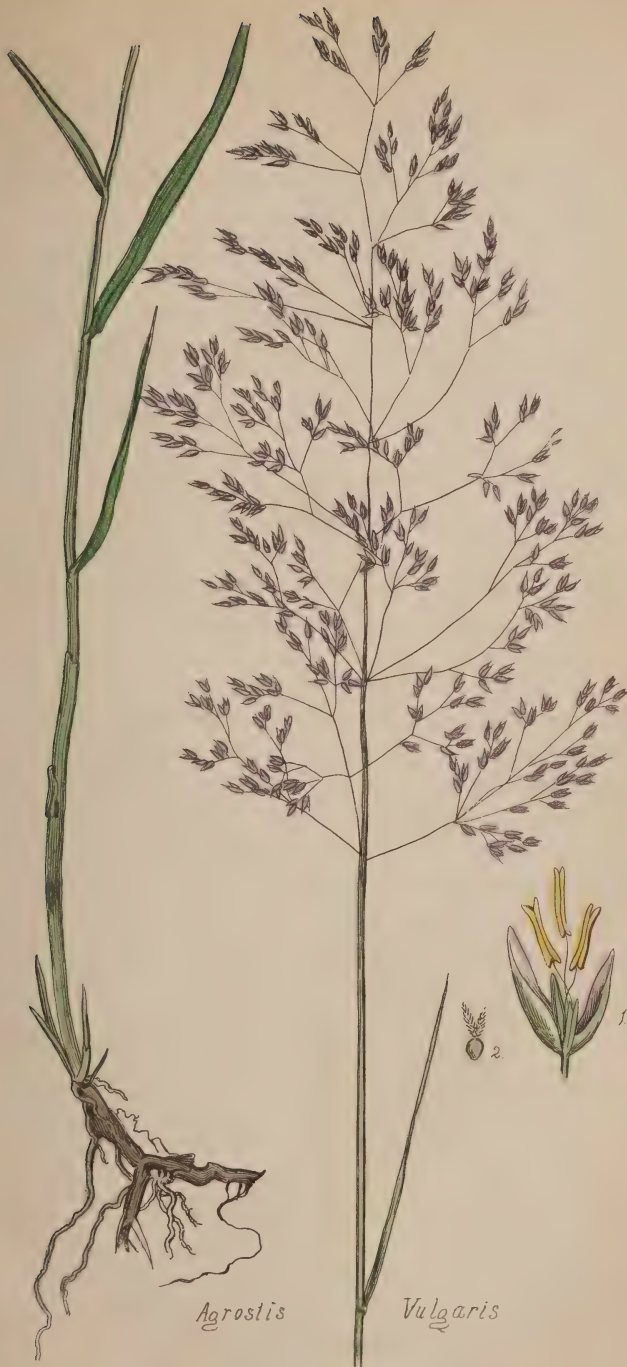
Experiments.—At the time of flowering, the produce from a siliceous sandy soil is 10,209 lbs. per acre.

The produce of latter-math is 2,722 lbs. per acre.

A given space of the above sandy soil, and another of a clayey loam, were sown with the seeds of this grass on the 20th of May, 1813. The seeds vegetated, and the produce was cut in the month of August following. The seeds of the creeping-rooted bent (*agrostis alba*), and of the larger creeping-bent or fiorin (*agrostis stolonifera*, var. *latifolia*), were likewise sown at the same time, and treated under the same circumstances.

The fiorin, in this experiment, is less productive on a clayey soil than the creeping-rooted bent, and even much less on the clayey than on the sandy soil; however, though its progress be at first slower on the clayey loam, yet, in the second year, the produce from the clayey loam was exactly triple the weight of that from the sandy soil. The fiorin afforded the greatest produce on the second and third years; after this, unless top-dressings are applied, the produce declines. On peat soils, this effect of the fibrous surface roots is much less. The common bent is one of the earliest of the bent grasses; in this respect it is superior to every other of this family, but inferior to several of them in the quantity of produce it affords and the nutritive matter it contains. It is the most common grass on natural sandy pastures; and even on more tenacious soils, that are elevated and exposed, it is frequent.

It flowers from the third week of June till the second week of July, and the seed is ripe the beginning of August.



Agrostis

Vulgaris

AGROSTIS vulgaris canina. Awned Fine Bent.

Specific character: Calyx valves nearly equal, blossom valves very unequal; awn jointed, twice the length of the corolla, fixed just below its middle. Native of Britain. Root fibrous, perennial.

Experiments.—At the time the seed is ripe, the produce from a sandy loam is 6,125 lbs. per acre.

Results go to prove, that the comparative merits of the *agrostis vulgaris* exceed those of the *agrostis vulgaris canina* nearly as 2 to 1. The crop of the awnless variety is greater than that of the awned, but is much less nutritive, being as 10 to 7: the spring and autumn produce is likewise superior. Neither of these varieties appears to be of much value to the farmer.

The brown bent flowers in the second and third weeks of July, and ripens the seed in the end of August.

AGROSTIS lobata. Lobed Bent, Sea-side Bent.

Specific character: Panicle spike-like, densely crowded with florets; calyx valves equal, acuminate, outer serrulated from the keel upwards, inner valve only towards the top, very unequal, egg-shaped. Native of Britain. Root perennial, fibrous.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil is 6,806 lbs. per acre.

The general appearance of this plant indicates the inferior comparative value manifested in the above details. I have never met with it in a wild state. It does not appear to be of much value to the agriculturist.

It flowers in the first week of August, and the seed is ripe about the end of the same month. Found near Epsom.

AGROSTIS stricta. Rock Bent, Upright Bent.

Trichodium rupestre.

Specific character: Panicle branches subdivided, roughish; calyx valves acuminate; blossom one valve, awned; awn fixed a little above the base.

Obs.—This species of bent is distinguished from the *agrostis vulgaris mutica*, and *agrostis vulgaris canina*, to which in habit it approaches, by the corolla or blossom being but of one valve; from the *agrostis nivea*, vel *trichodium niveum*, by the erect disposition of the stem, and the awn which is fixed but a little above the base of the valve: the valve has likewise two short awn-like points, which are a continuation of the nerves of the valve. The panicle is also less divided, more spear-shaped, and the calyx is acuminate. Whole plant of a fine deep green colour, by which it is distinguished at first sight from every other species of bent-grass. The culm of this species of *agrostis* is perfectly upright from the root, and not in the least decumbent or ascending in any part. Native of Britain? Root fibrous, perennial.

Experiments.—At the time of flowering, the produce from a bog soil is 9,528 lbs. per acre.

The produce of latter-math is 2,722 lbs. per acre.

As it will be found a vain attempt to cultivate or maintain grasses, on soils of a nature opposite to those which naturally produce them, it is therefore necessary, in ascertaining the comparative value of a grass, that its merits and properties be compared with those of such others only as affect a similar soil. If we compare the *agrostis vulgaris* with this species, it will be found superior in the proportion nearly of 5 to 3.

The *agrostis vulgaris* (common bent), affords in one season, per acre, of nutritive matter, 501 lbs., whereas this yields 314 lbs. only.

This species being therefore inferior to the common bent in most points, its value to the agriculturist can be but little.

AGROSTIS *nivea*. Snowy Bent, Straw-coloured Bent-grass.

Trichodium caninum, var. *stramineis arista calicem vix excedente*.

Specific character: Panicle branches subdivided, diverging, flexuose; calyx acute; corolla one-valved, valve



Aira flexuosa.

awned, awn longer than the valve, protruding from the back, fixed a little below the middle.

Experiments.— At the time of flowering, the produce from a sandy soil, incumbent on clay, is 6,125 lbs. per acre.

The produce of latter-math is 2,041 lbs. per acre.

On comparing the properties of this grass with those of the common bent (*agrostis vulgaris*), it will be found inferior in the proportion nearly of 5 to 3. It appears to be a very scarce grass: I have only seen it twice in a wild state, and then but in very small quantities. It grows on the east side of Aspley Wood, and by the side of a field near Wavendon.

It flowers about the second week of August, and ripens the seed about the beginning of September.

AGROSTIS *canina fascicularis*. Bundle-leaved Bent, Tufted Bent.

Variety with the leaves in dense bundles, and culms striking root at the joints.

Experiments.— At the time of flowering, the produce from a sandy soil is 2,722 lbs. per acre.

In old pastures, on light soils, this bent may be readily distinguished in the autumn by its shoots, which are furnished with leaves in tufts or bundles, that generally run along on the surface of the rest of the herbage, and is occasioned, apparently, by the cattle, which eat the other herbage, and leave the scattered shoots of the tufted-leaved bent untouched. It is a very common grass on poor, light, but moist soils, incumbent on clay, that have long been under pasture. This and the woolly soft-grass, in some parts of the country, are termed *winter-fog*.

From the above details it will appear to be the least valuable of the bent-grasses that have been mentioned.

Flowers in the first and second weeks of August, and ripens the seed in the end of the same month.

AIRA *flexuosa*. Zig-zag Hair-grass, Wavy Mountain Hair-grass.

Specific character: Panicle spreading, triple-forked, with wavy branches; florets about the length of the calyx, acute; awn from the middle of the outer valve, longer than the calyx, twisted; leaves bristle-shaped.

Obs. — The culms and leaves grow in dense tufts; the panicle, before the time of flowering, is of a fine glossy purple colour; the blossom is woolly at the base; awn knee-bent, half as long as the blossom; calyx generally two-flowered, rarely three; the inferior floret sitting.

Native of Britain. Root fibrous, perennial.

Experiments. — At the time of flowering, the produce from a heath soil incumbent on clay, is 10,209 lbs. per acre.

The produce of latter-math is 2,722 lbs. per acre.

The *aira flexuosa* is much more productive on its natural soil than the *festuca ovina*; but it requires a deeper soil, though not a richer. The *festuca ovina* is more common among heath (*erica vulgaris*), the *aira flexuosa* among furze (*ulex Europæus*), though both grasses frequently grow intermixed on the same soil. To those who attempt the improvement of such soils in a secondary manner only, this species of hair-grass appears to be the best of those grasses natural to the soils in question, and may form a principal part of a mixture of seeds for that purpose of improvement.

Flowers in the first week of July. Seed ripens in August.

POA *cenisia*. Soft Meadow-grass.

Specific character: Panicle diffuse, nodding; spikelets oblong, five-seven-flowered; florets connected at the base by a villus; sheath-scale short; root fibrous.

Obs. — This grass holds a place between the *poa laxa* and *poa alpina*. It differs from the first, to which it is nearest allied, in the culms being twice the height, and roundish towards the top; sheath-scale short; panicle diffuse, but always contracted before and after flowering; spikelets larger, oblong five to seven-flowered. From the *poa alpina* it differs also as above, but chiefly in the panicle, which is nodding, spikelets oblong, and florets free.

Native of Germany. Root perennial.

Experiments.— At the time of flowering, the produce from a sandy loam is 6,806 lbs. per acre.

This is an alpine species of grass, and attains to a greater size than most others of the same class ; but it is a native of the Alps of the fertile duchy of Carinthia, in Germany. It is rather late in the produce of foliage in the spring, and does not afford much after-grass. Its nutritive powers, as indicated by the quantity of nutritive matter it contains, are not superior to several other grasses that afford a greater abundance of herbage throughout the season. It produces flowers about the first and second weeks of July, and seeds in the second week of August.

STIPA pennata. Long-awned Feather-grass.

Generic character : Calyx 2-valved, 1-flowered ; corolla outer valve ending in an awn ; awn joined at the base.

Specific character : Awns woolly.

Obs.— Awns from six to twelve inches long or more, set with very fine, soft, white, pellucid hairs. In Ray's Synopsis, p. 393, this elegant grass is said to have been found by Dr. Richardson and Thomas Lawson, on the limestone rocks hanging over a little valley called Longsdale, about six miles north of Kendal, in Westmoreland. Hudson gives no other place of growth ; but in the second edition of Withering's Botanical Arrangement of British plants, Mr. Alderson is said to have found it near Kendal. Mr. Gough, who lives near Kendal, informs Dr. Withering, that he never could find nor hear of its being found by any person except the two first-mentioned gentlemen ; there is therefore reason to fear that it may be exterminated.

Experiments.— At the time of flowering, the produce from a heath soil is 9,528 lbs. per acre.

Though, so far as the above experiments prove, it cannot be propagated by the seed on a large scale, yet by parting the roots it may soon be propagated to any extent ; but its agricultural merits appear to be so inconsiderable as to rank it with the inferior grasses. The beautiful feather-like awns

which terminate the larger valves of the blossom, and which adhere to the seed, serving as a sail to waft it from rock to rock, have procured it a place in the flower-gardens of the curious, and serve to distinguish it at once from all other grasses. Johnson, the editor of Gerarde's Herbal, says it was nourished for its beauty in sundry of our English gardens; and that it was worn by sundry ladies and gentlewomen instead of a feather, which it admirably resembles, &c.

It flowers about the beginning of August, and the seed is ripe about the middle of September.

ALOPECURUS *agrestis*. Slender Fox-tail-grass.

Specific character : Culm erect, roughish; spike racemose, nearly simple, tapering; calyx glumes almost naked, combined at the base, dilated at the keel. *Ref.* 1. Calyx glumes magnified. 2. Corolla. 3. The same magnified, showing the awn. 4. Germen and styles.

Obs. — This annual species of fox-tail-grass, is distinguished from the perennial meadow fox-tail (*alopecurus pratensis*) by the total want of woolly hairs on the spike, so conspicuous in that of the *a. pratensis*. The husks of the calyx are united at the bottom and half-way up, which is a strong character of distinction. The culms are ascending at the base, afterwards erect. Spike-like panicle, round, acute-pointed, from two to four inches long, according to the nature of the soil; of a lead colour.

Native of Britain. Root annual, fibrous.

Experiments. — At the time of flowering, the produce from a sandy loam is 8,167 lbs. per acre.

The above details show this grass to be one of the most inferior species. The herbage it produces is comparatively of no value whatever. It appears to be left untouched by every description of cattle. The seed is produced in considerable abundance, and is eaten by the smaller birds as well as by pheasants and partridges. The Rev. G. Swayne observes, that it is a very troublesome weed in many places among wheat, and execrated by farmers under the name of

black bent. I have always found it prevalent in poor soils, particularly such as had been exhausted by avaricious cropping. It is most difficult to extirpate it when once in possession of the soil, for it sends forth flowering culms during the whole summer and autumn, till frost arrests it; so that it can bear to be repeatedly cut down in one season, without suffering essentially from the process. Indeed, it will be found a vain and unprofitable labour to attempt the removal of this grass, by any other means than the opposite of that which gave it possession of the soil, that is, judicious cropping.

To return land, in this state, to grass, in the hope of overcoming this unprofitable plant, will be found of little avail. I have witnessed this practice; and the slender fox-tail, instead of disappearing in these instances, re-appeared with the scanty herbage, and in greater health and abundance. The soil must first be got into *good heart* by very moderate and judicious cropping, which includes the proper application of manure, a skilful rotation of crops, and the most pointed attention to the destruction of weeds; which last can only be effected, in this sense, by adopting the drill or row culture for the crops. After this, the land may be returned to grass for several years with every prospect of success.

It flowers in the first week of July, and successively till October.

The appearance of the black-bent among wheat, is a certain sign that the crop will be worthless. On wet clayey gravels, if wheat be sown late in the autumn, this bent will certainly rise with the crop; but if the soil works kindly and rather dry, the wheat will prosper, and no bents will be seen; showing, that it is the bad condition of the tilth which favours the germination of the latter, and discourages the former. It is a remarkable fact, however, that there are some poor clayey soils, which if sown in a rather dry state, will cause the vegetation of every seed of the black bent, while the wheat will be stunted and hardly worth reaping.—ED.

AVENA pubescens. Downy Oat-grass.

Specific character: Panicle spreading equally on every

side; calyx three-flowered, shorter than the florets; leaves flat, downy.

Obs. — Root fibrous, inclining to stoloniferous; culms numerous, erect, rounded striated, smooth, from six inches to a foot, and two feet high, according to the nature of the soil and shelter; leaves flat and rough on the margin, the other parts soft, with downy hairs; florets purplish and silvery white; corolla bearded at the base, larger valve with an awn fixed at the middle, at first straight, afterwards jointed and bent back, longer than the valve. Native of Britain. Perennial.

Experiments. — At the time of flowering, the produce from a sandy loam is 15,654 lbs. per acre.

The produce of latter-math is 6,806 lbs. per acre.

The downy hairs which cover the surface of the leaves of this grass when growing on poor dry or chalky soils, almost disappear when cultivated on richer soils. It has properties which recommend it to the notice of the agriculturist, being hardy, and a small impoverisher of the soil; the reproductive power is also considerable, though the foliage does not attain to a great length, if left growing.

It flowers in the second or third week of June, and the seed is ripe about the beginning or in the middle of July.

MELICA cærulea. Purple Melic-grass.

Specific character: Petals beardless, acute; panicle close, erect, compound; flowers upright, cylindrical. Native of Britain. Perennial.

Experiments. — At the time of flowering, the produce from a light sandy soil is 7,486 lbs. per acre.

For the purposes of pasture or hay, this grass is comparatively of no value. It is said that goats, horses, and sheep eat it: I have laid it before cows and sheep, but they turned from it: I have observed hares to crop the foliage in the spring. The Rev. G. Swayne in Withering's Arrangements, informs us, that in the turf-moors below Glastonbury, Somersetshire, it grows in great abundance. The country people make of the straws a neat kind of besoms, which they

sell to the neighbouring inhabitants, as a cheap and no despicable substitute for hair brooms. In Anglesea it flourishes in the neighbourhood of the copper works of Pary's mountain, while almost every other vegetable, even lichens, are injured or destroyed. In deep sands, on the confines of peat-bogs, this grass is frequent; also from sand banks, under hedges enclosing heath soils, it is seldom absent. It grows to the greatest height on deep peat soils that are not subject to be overflowed, but dry for the most part of the year. This grass is useful to point out the fitness of such soils as that last mentioned for the production of ash, alder, and willow trees, &c.; and it will be found, that on such parts of the peat as are destitute of this grass they will not succeed so well, if at all.

It flowers about the beginning and middle of August, and the seed is ripe towards the middle and latter end of September.

NARDUS stricta. Upright Matt-grass.

Specific character: Spike slender, straight; the florets pointing in one direction; leaves thrice the length of their sheaths.

Obs. — Culm with a single joint near its base, and one bristle-like leaf. Root-leaves long, thread-shaped. Florets all pointing one way; before flowering, pressed close to the spike-stalk, which has small excavations to receive the florets, afterwards spreading out. The culm is twice the length, at the time the seed is ripe, of what it is at the time of flowering. Root fixed firmly in the ground, on account of its tenacious fibres, which take a flexuose direction. On precipices, therefore, its dense tufts of leaves, though dangerous to the footing, afford to the hand of the botanist or naturalist the best security from the danger of falling. “Gramen invisum naturæ alpestris scrutatoribus, quod vias lubricas reddat; sed quod densis cespitibus crescat, firmiterque terræ inhæreat, sæpe etiam gratissimum in præcipitiis, quod profundissime ad radicem manu prehensum impediatur lapsum.” Native of Britain. Root fibrous. Perennial.

Experiments. — At the time of flowering, the produce from a heath loam is 6,806 lbs. per acre.

The latter-math produce of this grass is very small. It is common to heaths and by the margins of bogs, but is never found in the bogs themselves, as it affects a dry soil. The nutritive matter offers no reason for the dislike manifested by animals for the grass, as its composition is much the same as that of the *aira flexuosa*, which is eaten with relish by sheep; the only difference is in the proportion of sugar: the *aira flexuosa* having more of this constituent and less of mucilage than the *nardus stricta*. But the extreme hard and wiry nature of the foliage explains the cause. That property is so strong in this grass that, in the ordinary way, a scythe is passed amongst it without having the effect of dividing a single leaf; and from this it may easily be conceived how ungrateful it must prove to the mouths of cattle. Were it not for this circumstance, and its continuing to send up flowering culms all the summer, it would be the most ornamental grass for forming grass-plats, as its colour is of the finest dark green, being superior in this respect to all the perennial grasses. Linnæus observes, that goats and horses eat it, and that sheep are not fond of it. Crows stock it up for the sake of the larvæ of some species of tipulæ which they find at the root.

It flowers in the first and second weeks of July, and the seed is ripe about the first week of August.

CYNODON *dactylon*. Creeping Dog's-tooth Grass.

Durva, *Dub*, or Doob-grass of the Hindoos. *Panicum dactylon*. Creeping Panic-grass. *Digitaria stolonifera*. Creeping Finger-grass.

Specific character: Spikes four or five, crowded together; corolla smooth.

Refer. — *Fig.* 1. Corolla, natural size. 2. Floret, magnified. 3. Calyx, magnified. 4. Germen, and feathery stigmas. 5. A seed, the natural size. 6. A seed, magnified.

A. B. Lambert, Esq. in the Transactions of the Linnean



Cynodon Dactylon.

Society, vol. vi, first pointed out the identity of the *panicum dactylon* with the doob-grass of the Hindoos. The seeds of this highly celebrated grass in India, were communicated to the Duke of Bedford, from the East Indies, by the Marquis of Hastings. The seeds were sown in the Experimental Grass Garden at Woburn Abbey, where they vegetated readily, and produced plants which flowered the second year from seed. These perfected seed in the month of October, and the plants raised from this seed the following spring differed in no respect from those the produce of the Indian seed; our figure is taken from a plant of the later sowing. A portion of the seed was sown in the hothouse, and the plants cultivated there, in order to ascertain the effects of climate on the habit of the grass. Exposed in the Grass Garden, and cultivated by the side of the English species, the habit of the Indian plants differed from the former in the shortness of the leaves, which grew nearly flat on the ground, and were of a reddish brown colour, instead of the slight glaucous green tint of the native English plant. The foreign plants flower freely every season, but the native ones of this species of grass very seldom, for during fifteen years the native plants have twice, only, produced flowers. In the hothouse, the Indian plants proved of a habit exactly the same as the native plants in the open ground, having the leaves equally as long as those of the latter, of their glaucous colour, and not producing any flowering culms. This last fact is a very remarkable one as connected with the long-continued effects of different climates on the same species of plant. In the hothouse more soluble or nutritive matter, and also more vegetable or woody fibre, were afforded by this grass than was afforded by the plants of it cultivated out of doors in the Grass Garden.

Experiments. — At the time of flowering, the produce of the native plant from a sandy loam, with manure, is 31,308 lbs. per acre.

The doob-grass, or plants raised from Indian seed, at the time of flowering, from a sandy loam in the Grass Garden, afforded 2,722 lbs. per acre.

The grass, cultivated in an artificial tropical climate in the

hothouse, contained a superior quantity of nutritive matter to that cultivated in the open air in the Grass Garden, in the proportion nearly of 39 to 31; and the woody fibre afforded by the grass of the plants cultivated in the hothouse exceeded the woody fibre contained in the grass of the plants cultivated in the open air in the proportion of 4 to 3.

In the East Indies the doob-grass grows luxuriantly, and is highly valued as food for horses, &c.; in this climate, however, it scarcely begins to vegetate till the month of June: and the above details show that its produce and nutritive powers here are not sufficiently great to hold out any hope, that its valuable properties in the East Indies can be made available in the climate and soil of Britain.

Sir William James, in his works, gives a figure of the doob-grass. The essential specific characters of the grass, as exhibited in the figure given by Sir William Jones, and those which our figure present, are precisely the same; the greater size or luxuriance of growth indicated by the former figure, is clearly the effects of climate, one plant being the produce of the East Indies, and the other the growth of England.

Sir William Jones observes, "That every law-book, and almost every poem, in Sanscrit, contains frequent allusions to the holiness of this plant; and in the fourth Veda we have the following address to it, at the close of a terrible incantation: — 'Thee, O Darbha! the learned proclaim a Divinity not subject to age or death; thee they call the armour of Indra, the preserver of regions, the destroyer of enemies, a gem that gives increase to the fields; at the time when the ocean resounded, when the clouds murmured and lightnings flashed, then was Darbha produced, pure as a drop of fine gold.' — Again, 'May Durva, which rose from the water of life, which has a hundred roots and a hundred stems, efface a hundred of my sins, and prolong my existence on earth for a hundred years.'"

The doob-grass flowers in September, and the seed is ripe about the end of October, and sometimes in November. The plants, natives of the English coasts, flower about a month earlier than the above.

PANICUM viride. Green Panic-grass.

Specific character : Panicle spiked, cylindrical, continuous, with numerous prominent bristles, rough with erect teeth ; corolla of the perfect floret slightly uneven. Native of Britain. Root annual.

Experiments. — At the time the seed is ripe, the produce from a rich siliceous soil, incumbent on clay, is 5,445 lbs. per acre.

This species of panic-grass is therefore of little value to the agriculturist, and as it is far from being a common grass, it is not much to be feared as a weed.

It flowers in the second and third weeks of July, when sown in the preceding autumn, and the seed is ripe about the middle of August ; but it continues to flower till the cold prevents it.

DIGITARIA sanguinalis. Slender-spiked Finger-grass,
Cock's-foot Finger-grass. *Panicum sanguinale.* Slender-spiked Panic-grass.

Specific character : Leaves and their sheaths somewhat hairy ; flowers in pairs ; calyx rough at the edges of its largest valve only.

Native of Britain. Root annual.

Experiments. — At the time of flowering, the produce from a sandy soil is 6,806 lbs. per acre.

This and the foregoing species are strictly annual plants. From the above details, the nutritive powers of the herbage they produce is very inconsiderable. Schreber informs us, the seeds are collected from this grass, which is cultivated in some parts of Germany as a favourite article of food. When boiled with milk or wine it is extremely palatable, and is in general made use of whole, in the manner of sago, to which it is, in most instances, preferred. Miss Jennings observes, that all the stems that lie nearest the ground strike root, and by this means, though an annual and short-

lived plant, it increases and spreads very wide in one season. It should be sown as soon as the seed is ripe in the autumn, that the young plants may have sufficient strength before the winter begins; by this mode of culture it will flower and ripen the seed much earlier than the time specified below; in that instance the seeds were sown in May.

It delights most in a rich, light, siliceous soil. It is said to have received the name *sanguinale*, not from its colour, but from a mischievous trick of boys in Germany, thrusting the spikelets up the noses of their companions, thereby making them bleed.

It flowers about the first week of August, and the seed is ripe in the middle of September.

BROMUS *sterilis*. Barren Brome-grass.

Specific character: Panicle drooping, mostly simple; spikelets linear-lanceolate; florets about seven, lanceolate, compressed, seven-ribbed, furrowed; awns longer than the glumes; leaves downy.

Native of Britain. Root annual.

Experiments.—At the time of flowering, the produce from a sandy soil is 29,947 lbs. per acre.

It has been asserted that the seeds of this grass seldom arrive at maturity; but there is hardly a grass, either in a natural or cultivated state, that ripens more seed than the barren brome-grass. Mr. Curtis affirms, that it acquired the name *sterilis*, or barren, from its inutility with respect to cattle: which appears most probable. Ray calls it great wild oat-grass, or drank.

The long sharp awns with which the spikelets are armed must prevent cattle from eating it. It grows chiefly under hedges, and on banks by the road-sides, where it is very common; but it is seldom found beyond the reach of the shade. I never could observe that any of it had been touched by cattle.

It flowers in the first and second weeks of July, and the seed is ripe about the beginning and middle of August.

BROMUS diandrus. Upright Annual Brome-grass.

Specific character: Panicle erect, a little spreading, scarcely subdivided; florets lanceolate, with two close marginal ribs, and only two stamens.

Native of Britain. Root annual.

Experiments. — At the time of flowering, the produce from a rich brown loam is 20,418 lbs. per acre.

This, like the preceding species of *bromus*, is strictly annual. It is much less common than the *bromus sterilis*: Hudson informs us that it grows on old walls in the neighbourhood of London and Oxford.

It flowers in the third week of June, and the seed is ripe about the middle and latter end of July.

BROMUS tectorum. Nodding Panicked Brome-grass.

Specific character: Panicle branches drooping; spikelets linear, pubescent; florets distant, awned, awn as long as the glume; leaves pubescent.

Native of Britain, discovered by Mr. Taunton. It is found in most parts of Europe. Root annual.

Experiments. — At the time of flowering, the produce from a light sandy soil is 7,486 lbs. per acre.

This is another of the annual bromes which is comparatively of no value. Dambourney, indeed, says, that at the time it approaches to a state of maturity, it may be useful in dyeing, when it can be collected in sufficient quantity. Birds are fond of the seed, and the plants require protection before the seed be perfected, in order to secure a sufficient supply for the next year's sowing.

It may be remarked from the facts that have been brought forward respecting the annual bromes, that most of them, comparatively, afford more nutritive matter at the time they are in flower, than some of the best perennial grasses at the same stage of growth. The reason of this appears on considering, that the whole of the nutritive matter which is accumulated in one year by these annuals, is present in the

plant at this period or shortly after; for when the seed is ripe, the straws contain but a small proportion of nutritive matter; and the seed itself contains little more than the plants afforded at the time of flowering, the difference being as 7 to 5: which seems to prove that the culms and leaves, a little after the time of flowering, contain nearly all the nutritive matter which passes into, or constitutes the substance of the seed.

It flowers in the third week of June, and the seed is ripe about the end of July.

AGROSTIS canina capillaris. Fine-panicled Brown Bent.

Variety with a hair-like panicle, spreading, flexuose, calyces subulate, equal, smooth, coloured. This variety is nearly akin to the *agrostis canina fascicularis*; it grows pretty common in some parts of Woburn Park, where the soil is siliceous.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a sandy loam is 4,764 lbs. per acre.

The above details afford no proofs of the value of this for agricultural purposes. It is found in a wild state, on heaths chiefly. I never observed that even hares cropped its herbage. Its manner of growth is similar to that of the *agrostis fascicularis*, only that the leaves are not produced in bundles or tufts, which is so distinguishing a feature of that grass. It is seldom combined with any other species of grass, but grows in detached patches on moors and heaths.

It flowers about the beginning of August, and the seed is ripe about the end of that month.

ALOPECURUS geniculatus bulbosus. Bulbous-rooted knee-jointed Foxtail-grass.

Obs.—Root of this variety bulbous; awns longer than the blossom; sheaths wider than the thickness of the straw; anthers purple, and changing to a brown-yellow.

Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam is 5,445 lbs. per acre.

The produce and nutritive powers of this grass are evidently so inconsiderable as to justify a conclusion that it is comparatively of no use to the agriculturist. I have found it but seldom in a wild state. It grows on a soil of a drier nature than the fibrous-rooted variety, to be spoken of hereafter. When raised from seed on a moist soil, it still retains the bulbous root, which goes the length to prove, that if it be not a distinct *species*, it is at least a permanent *variety*.

POA alpina. Alpine Meadow-grass.

Specific character: Panicle diffused, four to eleven-flowered, cordate; florets acute, free; sheath-scale oblong, acute; leaves short, obtuse, pointed; root fibrous.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a light sandy loam is 5,445 lbs. per acre.

The produce of this grass appears, from these experiments, to be equal to that of the *alopecurus alpinus*, and its nutritive powers greater; but not sufficiently great to render it an object for the farmer's particular consideration. It is chiefly confined to alpine regions. It grows wild in Scotland and Wales, also in Lapland, Switzerland, and Silesia.

Botanists inform us, that mountainous countries are furnished with a much greater variety of plants than flat countries; and that in primitive mountains the number of different species of plants exceeds that of the floetz mountains. This has led to the opinion, that the primitive mountains were the sources from which the plains, clothed at a later period, were furnished with plants.

The Alpine meadow-grass flowers about the third week of May, and during the rest of the summer; and the seed ripens about the latter end of June, and successively, according as the grass produces flowers. Hares and rabbits are remarkably fond of this grass, and snails devour the flowering spikelets of the panicle; it requires therefore

much care and attention to obtain either seed or perfect specimens of the flowers.

SESLERIA *cærulea*. Blue Moor-grass, or *cynosurus cæruleus*.

Specific character: Spike egg-oblong, leafy; bractæas alternate; spikelets two-three-flowered; outer husk of the corolla with three, seldom five awns; awns shorter than the husk.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a light sandy soil incumbent on clay is 7,486 lbs. per acre. The produce of latter-math is 3,403 lbs. per acre.

If the weight of produce, and the nutritive matter it contains, be compared with those of the alpine grasses that are included in this series of experiments, the blue moor-grass will be found greatly superior. It is said to grow wild in mountainous pastures in the north of England, and sometimes in marshes, in crevices of the limestone rocks at the foot of Ingleborough lime rocks near Kendal, Malham Cone, and on most of the lime rocks in Craven, Yorkshire.

Though, as already observed, it is the best of the alpine grasses, yet the above details of its properties do not warrant any recommendation of its cultivation to the farmer.

Cynosurus cæruleus is particularly liked by sheep, and may be used for the fattening of mutton, but makes the wool coarse.—*Observation by the Wetterauer Gesellschaft*.

It flowers about the end of April and the beginning of May, and the seed is ripe in the first and second weeks of June.

AIRA *cristata*. Crested Hair-grass; or *Poa cristata*, Crested Meadow-grass.

Specific character: Panicle spike-like; husks acuminate; flowers longer than the calyx; leaves ciliated; glumes all pointed.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a sandy loam is 10,890 lbs. per acre.

The produce of this species, and the nutritive matter it affords, are equal to those of the *festuca ovina* at the time the seed is ripe; they equally delight in dry soils, though the *aira cristata* will thrive well, and remain permanent, in soils of a moist and clayey nature, which is different with the *festuca ovina*. The greater bulk of the produce of the *aira cristata*, in proportion to its weight, makes it of inferior value to the *festuca ovina*.

It flowers about the first week in July, and the seed is ripe about the beginning of August.

POA compressa. Flat-stalked Meadow-grass.

Specific character: Panicle flowering on one side, rather dense; spikelets oval-oblong, five-seven-flowering; flowers connected at the base by a complicated web of hairs; culm compressed; root creeping.

Native of Britain. Root perennial, creeping.

Experiments.—At the time of flowering, the produce from a gravelly soil with manure is 3,403 lbs. per acre.

If the produce of this grass was of greater magnitude, it would rank as one of the most valuable grasses, as it produces foliage early in the spring, of stronger nutritive powers than most other grasses. It has been recommended as a grass to cultivate on poor soils; but the produce is so very deficient, that there are other grasses that might better answer the end, as the meadow-barley oat, hard fescue, and crested dog's-tail-grass. The roots, in some situations, penetrate to a considerable depth, as in stony dry soils. It grows in abundance on the walls which embank the ponds in Woburn Park.

Dr. Smith, in the English Botany, observes, that this grass can scarcely be put to any agricultural use: the trials that have been made of it here confirm that opinion.

It flowers in the second week of July, and the seed is ripe about the middle of August.

POA compressa, var. *erecta*. Upright Flat-stalked Meadow-grass.

Obs.—This differs from the former variety of *poa compressa* in having culms more upright, less compressed, and produced in greater quantities. The colour of the leaves is somewhat glaucous; they grow more upright than those of the other variety. Root creeping like that of the former, but furnished with numerous fibres, which supply culms and leaves in abundance; the plant soon forms a close covering to the ground, while the other remains in a scattered state.

Experiments.—At the time of flowering, the produce from a light sandy loam is 15,654 lbs. per acre.

The produce of latter-math is 4,764 lbs. per acre.

This variety of the flat-stalked meadow-grass affects a soil of a moister and more rich nature than the first-mentioned variety. It grows more close, forming a pretty good sward; the roots are less inclined to creeping. It sends up a great quantity of flowering culms, which constitute the principal weight of the produce, and remain green and succulent long after the seed is ripe; on this account the seed crop contains so much more nutritive matter than the flowering crop. It is a week or ten days later in flowering than the former variety, and the produce of foliage in the spring is likewise inferior. What was said respecting the merits of the first variety may also be said of this one; for though its produce be greater, and form a better turf, yet it is inferior in early growth, and in the produce of foliage.

It flowers in the end of July, and the seed is ripe about the beginning of September.

LOTUS corniculatus. Bird's-foot Trefoil, Bird's-foot Clover.

Generic character: Legume cylindrical, straight; wings of the corolla cohering by their upper edge; calyx tubular; filaments dilated upwards.—*Refer. Fig.* 1. Calyx and anthers magnified. 2. Flower, of the natural size.



Poa Compressa

Erecta.



Lotus Corniculatus.

Specific character: Heads depressed, of few flowers; stems decumbent, solid; legumes spreading, nearly cylindrical; claw of the keel obovate; filaments all dilated.

Native of Britain, and all parts of Europe; also of Japan.
Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 10,209 lbs. per acre.

This plant has been recommended for cultivation by Dr. Anderson, Mr. Curtis, and Mr. Woodward. Linnæus says that cows, goats, and horses eat it; and that sheep and swine are not fond of it. With regard to sheep, as far as my observations have extended, they eat it in common with the herbage with which it is usually combined; the flowers, it is true, appeared always untouched, and, in dry pastures, little of the plant is seen or presented to cattle, except the flowers, on account of its diminutive growth in such situations. This, however, is nearly the case with white or Dutch clover; sheep seldom touch the flowers while any foliage is to be found.

Mr. Woodward informs us that it makes extremely good hay in moist meadows, where it grows to a greater height than the trefoils, and seems to be of a quality equal, if not superior to most of them. Professor Martyn observes, that, in common with several other leguminous plants, it gives a substance to hay, and perhaps renders it more palatable and wholesome to cattle. It has been already observed, that the clovers contain more bitter extractive and saline matters than the proper natural grasses, and the bird's-foot trefoils contain more of these vegetable principles than the clovers; in pastures and meadows, therefore, where the clovers happen to be in small quantities, a portion of the trefoil (*lotus corniculatus*) would doubtless be of advantage; but it appears to contain too much of the bitter extractive and saline matters to be cultivated by itself, or without a large intermixture of other plants.

It does not spring early in the season, but continues to vegetate late in the autumn. In irrigated meadows, where

the produce is generally more succulent than in dry pastures, this plant cannot with safety be recommended, at least in any considerable quantity. It is more partial to dry soils than the next species, *lotus major*; it attains to a considerable height when growing among shrubs, and seems to lose its prostrate or trailing habit of growth entirely when in such situations.

It comes into flower about the second week of June, and the seed is ripe about the end of July, and successively till the end of autumn.

LOTUS *major*. Greater Bird's-foot Trefoil.

Specific character: Heads depressed, many-flowered; stems erect, hollow; legumes spreading, cylindrical; claw of the keel linear, shorter, filaments not dilated.

Obs.—Stems from one to two and a half feet high, according as it is more or less drawn up by bushes, or exposed without shade, more or less fringed with long loosely-spreading hairs; leaves also more or less fringed with similar hairs; flower-heads when young very hairy, flowers from six to twelve in each head, of a duller orange than the preceding species; pod slender, and exactly cylindrical.—I have raised this plant from seed on two different soils, a siliceous sandy soil and a clayey loam, and the above characters remain permanent in both instances: it is surprising that two plants so distinct in habits should have so long been considered varieties only.

Native of Britain. Root perennial, creeping.

Experiments.—At the time of flowering, the produce from a clayey loam is 21,780 lbs. per acre.

The weight of green food, or hay, is triple that of the foregoing species, and its nutritive powers are very little inferior, being only as 9 to 8. These two species of bird's-foot trefoil may be compared to each other with respect to habits, in the same manner as the white clover and perennial red clover; and were the latter unknown, there appear to

be no plants of the leguminous order, that, in point of habits, would so well supply their place as the common and greater bird's-foot trefoil. They are, however, greatly inferior to the clovers. The white clover is superior to the common bird's-foot trefoil in the quantity of nutritive matter it affords, in the proportion of 5 to 4. It is much less productive of herbage, and is much more difficult of cultivation, the seed being afforded in much smaller quantities. The produce of the greater bird's-foot trefoil is superior to that of the perennial red clover, on tenacious or moist soils, and on drier, and on richer soils of the first quality; but the produce is inferior, in the proportion of nutritive matter it contains, as 5 to 4. The nutritive matter of this species contains more bitter extractive and saline matters than that of the former, which was before shown to be in excess when compared with the clovers, and these with the proper natural grasses. The nutritive matter is extremely bitter to the taste. It does not appear to be eaten by any cattle when in a green state; but when made into hay with the common grasses, I have offered it to sheep, oxen, deer, and the llama, or South American sheep, and they all ate it without reluctance, and rather with desire.

It does not seem to perfect so much seed as the former species; but this is abundantly remedied in its propagation by the creeping or stoloniferous roots, which it spreads out in all directions, and thus it soon covers a large space of ground. But the stems rise not in considerable number; they are thinly scattered over the surface. In moist clayey soils it would doubtless be a most profitable substitute for red clover; but the excess of bitter extractive and saline matters it contains, seems to forbid its adoption without a considerable admixture of other plants.

It flowers about the third week of June, and the seed is ripe about the end of the following month.

AVENA pratensis. Meadow Oat-grass.

Specific character: Panicle erect, with very short simple branches; florets about five, longer than the calyx;

partial stalk, all over hairy; leaves involute, finely serrated, naked; sheaths smooth.

Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam is 6,806 lbs. per acre.

The proportional value which the crop at the time of flowering bears to that at the time the seed is ripe, is as 9 to 4.

This species of oat-grass is much less common than the *avena pubescens* or *avena flavescens*. It is found more frequent on chalky than on any other kind of soils: I have also found it in moist meadows as well as on dry heaths.

From these observations, it cannot justly be recommended for cultivation. Its nutritive matter contains a less proportion of bitter extractive and saline matters than any other of the oat-grasses that have been submitted to experiment.

It flowers in July, and the seed is ripe in August.

HORDEUM *pratense*. Meadow Barley-grass.

Specific character: Lateral flowers imperfect, with shorter awns; all the calyx valves bristle-shaped and rough.

—*Refer.* Fig. 1. Neuter florets. 2. Perfect floret.

3. Germen, feathered stigmas, and nectary.

Obs.—This species has affinity to the *hordeum murinum*, wall barley-grass, in appearance; but this is strictly perennial, while the *hordeum murinum* is annual.

Native of Britain. Root fibrous. Perennial.

Experiments.—At the time of flowering, the produce from a sandy loam with manure is 8,167 lbs. per acre.

The grass, at the time of flowering, contains more nutritive matter than at the time the seed is ripe, in the proportion of 15 to 12.

This grass, though said to be partial to dry chalky soils, I have always found most prevalent on good rich meadow ground; it thrives under irrigation; and there are but few pastures in which it is not to be found; dry sandy heaths, and moist sour soils, are uncongenial to it. The Rev. G. Swayne observes, that in moist meadows it produces a



Hordeum Pratense

Avena Pratense

considerable quantity of hay, but is not to be recommended as one of the best grasses for the farmer. The best grasses, in my opinion, continues Mr. Swayne, are the *alopecurus pratensis*, *poa trivialis*, *dactylis glomerata*, *cynosurus cristatus*, *festuca duriuscula*, *festuca pratensis*, *festuca hybrida*, *avena flavescens*, and above all, the *lotium perenne*. If gardeners and farmers are so careful, as we know they are, in raising the seeds of their turnips and cabbages, surely some of their care is due to the cultivated grasses. I have observed this grass to constitute the principal herbage of one or two pastures that were considered excellent for sheep. I have been informed, likewise, that in some pastures in Norfolk this grass forms the principal herbage; and the proprietors of the lands in question are famed for their superior breed of sheep. Though this proves nothing positive with respect to the merit of the grass, nevertheless, it offers satisfactory reasons to conclude that the grass is not hurtful in sheep pasture, which is not the case when it is made into hay; the long sharp awns with which the spikelets are armed rendering it dangerous to the mouths of cattle, and forming a serious objection to its introduction (at least in large quantities) into irrigated meadows, where the produce is, in part, every year converted into hay. It is tolerably early in the spring produce of foliage, and its nutritive powers are considerable. It is very hardy, and strictly perennial.

Flowers in July, and the seed is ripe in August.

TRITICUM cristatum. Crested Wheat-grass. *Bromus cristatus.* Crested Brome-grass.

Specific character: Calyx elliptical, awned, keeled, obscurely ribbed; florets awned; spikelets closely imbricated, two-ranked, depressed, straight; stems simple.

Native of Scotland. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 8,848 lbs. per acre.

The produce of latter-math is 2,722 lbs. per acre.

The grass at the time of flowering contains more nutritive matter than the grass at the time the seed is ripe, in the

proportion of 10 to 9; and the grass of the latter-math is inferior to that at the time of flowering as 8 to 10; and to the grass at the time the seed is ripe, in the proportion of 8 to 9.

It flowers about the second week of July, and the seed is ripe about the end of August.

PHLEUM *Boehmeri*. Purple-stalked Cat's-tail Grass. *Phalaris phleoides*. Cat's-tail Canary-Grass.

Specific character: Panicle like a spike, cylindrical; husks of the calyx linear-lanceolate, slightly pointed, nearly smooth, abrupt at the inner margin; stem simple.

Native of Britain. Root fibrous, perennial.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil is 6,806 lbs. per acre.

The produce of foliage in the spring from this grass is comparatively nothing, as is the case with the latter-math produce. The root-leaves are remarkably short in this species of canary-grass, and the culms are numerous. At the time of flowering, the produce may be said to consist entirely of culms. It grows naturally in dry sandy places; said to have been first discovered in Great Britain by Mr. Woodward and Mr. Crow, near Swaffham, Norfolk, in 1780. It is also a native of Germany, where it grows in pastures, orchards, hills, and dry sandy barren places. It is evidently unfit for cultivation in the farm, as the above produce constitutes what it yields in one season, and which, when compared with that of most other grasses affecting a similar soil, proves greatly inferior. It ripens plenty of seed for its propagation.

It flowers in July, and the seed is ripe in the beginning of September.

FESTUCA *alopecurus*. Fox-tail-like Fescue-grass.

Specific character: Spike erect, attenuated; calyx-valves very unequal, outer large, three-nerved, acuminate, inner very minute, awl-shaped; corolla, outer valve

awned, largely ciliate at the edges; inner two-ribbed, slightly ciliate on the ribs.

Native of Barbary. Root annual.

Experiments.—At the time of flowering, the produce from a light siliceous sandy soil is 8,167 lbs. per acre.

If this annual fescue be compared with the soft brome-grass, many-flowered brome-grass, and others of the annual indigenous grasses, it will be found inferior. The leaves attain to a considerable length, and contain more nutritive matter than those of any other annual grasses that have been submitted to experiment here; the culms, however, contain much less nutritive matter than those of most other annuals. It ripens the seed in sufficient quantity, affects most a light rich soil, and is strictly annual. The best time for sowing the seed is in the beginning of May.

It flowers about the end of July, and the seed is ripe in the beginning of September.

CYNOSURUS *echinatus*. Rough Dog's-tail Grass.

Specific character: Spike compound, ovate; neuter spikelets awned; awns of the corolla full as long as the glume.

Native of Britain. Root annual.

Experiments.—At the time of flowering, the produce from a sandy loam is 5,445 lbs. per acre.

This grass is not common; it is found in a wild state near Sandwich, and in the Isle of Jersey, on a sandy soil. It is also a native of Germany, growing in pastures, corn-fields, and on sands by the sea-side. Like the preceding grass, this one is evidently of more use in showing the diversity of form that gives specific characters to the individuals composing a genera, than to any agricultural purpose to which it can be made subservient; as the above results of experiments made upon it, put every idea of that nature out of the question.

Flowers about the end of June, and the seed is ripe in August.

POA *distans*. Reflexed Meadow-grass, or *Glyceria distans*,
Reflexed Sweet-grass.

Specific character: Panicle equal, divaricated; branches finally reflexed; spikelets linear, five-flowered; florets blunt, distant, obsoletely five-nerved.

Obs.—Culms from six to eighteen inches high, round, striated, smooth, obliquely ascending, procumbent from the base to the first joint, sending out branches. Leaves with long sheaths, sharpish, even, glaucous, flat; the root-leaves a little rolled in. Panicle erect, with the branches in half whirls, angular, rugged, somewhat flexuose, branches of various lengths; finally much bent. Spikelets linear, from four to seven-flowered, variegated with white or purple. Florets remote, sub-cylindrical, very blunt, retuse, five-nerved, scariose at the tip, with the inner glumes emarginate.

Native of Britain. Root fibrous. Annual when cultivated in exposed situations. Perennial in its natural place of growth.

Experiments.—At the time of flowering, the produce from a sandy loam is 4,764 lbs. per acre.

Mr. Curtis observes of this grass, that, though at first sight it bears a near resemblance to the *poa annua*, and no doubt is often mistaken for it, yet it is considerably taller, its leaves narrower in proportion, and much more glaucous; its spikelets are also much narrower, as well as longer, and of course contain many more florets, which are, for the most part, prettily variegated with pale green and purple; but the chief character which distinguishes this from *poa annua* and all other species, is to be drawn from the branches of the panicle; these, as the plant goes out of bloom, are reflected, or stretched out backwards, so as sometimes to touch the culm; this is effected by little tubercles at the base of the branches on their upper side only, which increasing in size as the plant advances in its flowering, forces them backwards. Mr. Curtis further informs us, that six years' cul-

ture made no alteration in the appearance of this grass, and that there did not appear sufficient merit in it to recommend it for agricultural purposes.

The results of the above experiments confirm the opinion expressed by Mr. Curtis, and rank the reflexed meadow-grass with the most inferior of the British grasses. It is chiefly, though not exclusively, confined to maritime situations.

It flowers about the end of May when cultivated in warm situations, and continues to send up flowering culms till the middle of September. The seed is generally ripe in about six weeks after the time of flowering.

MEDICAGO lupulina. Black Nonsuch, Trefoil Medick.

Specific character: Spikes oval; seed-vessel kidney-shaped, with one cell and one seed; stems trailing.

Obs.—Stems trailing, unless supported by the plants with which it grows; about a foot long, somewhat angular, slightly hairy, branched. Leaves obovate, or wedge-shaped, tooth towards the top, the mid-rib lengthened out to a short broad point, soft, pubescent, particularly on the under side. Flowers small, yellow, from thirty to forty, and upwards, in a head which is at first roundish, afterwards oval. Legume striated and wrinkled, somewhat hisped with rigid hairs, turning black when ripe. Seed ovate, smooth, yellowish. This plant has such general resemblance to the proper trefoils or clovers, that it is often mistaken for some of the smaller species. The form and colour of the seed-pods afford a ready mark of distinction.

Native of Britain. Root annual; in some situations biennial.

Experiments.—At the time of flowering, the produce from a sandy loam is 13,612 lbs. per acre.

We are informed in Mr. Young's Annals of Agriculture, that this plant has been much sown of late years for sheep food in open fields, where it is a considerable improvement, first, for the sweet food, and then, to help the land by

ploughing it in, getting a good crop of wheat after it on indifferent soils. Mr. Zappa, of Milan, says, that it likes deep ground, rich, and exposed to the sun; multiplies very well from the seed, grows chiefly in the spring, flowering at the beginning of May, and ripening the seed at the beginning of June; it grows but little towards the end of summer and autumn. It is cut with *poa trivialis*, fifteen inches high, but is naturally procumbent. The seed of this plant falls so readily that great loss ensues from moving it, and, in thrashing, the least stroke clears it. It is a good way, therefore, to thrash it in the field on a cloth, which is moved to the seed, and not the seed to the cloth. This account, extracted from Mr. Young's Annals, perfectly agrees with what I have observed of the habits of this plant, only that it does not flower here till the middle or end of May. For light soils only it appears to be adapted, and these must be deep, as the root penetrates to a considerable depth, and is but little fibrous. It does not appear fit for separate cultivation, nor even to be employed in a large proportion in a mixture of other seeds. The root is annual, or at most a two-year-lived plant, and its use is therefore confined to the alternate husbandry. To sow the seeds of this plant with others on land intended to remain for permanent pasture, would be subversive of the intention; as every spot this plant occupied would be naked the second year; and these spots afford every encouragement to the growth of weeds, as well as the decaying roots afford nourishment to the life of grubs.

HEDYSARUM *onobrychis*, Sainfoin, or Cock's-head.

Generic character: Keel transversely obtuse; legume jointed, with one seed in each joint.

Specific character: Legumes one-seeded, prickly; wings of the corolla equal in length to the calyx; stem elongated.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a poor siliceous sandy soil is 6,806 lbs. per acre.

The produce of sainfoin on a clayey loam with a sandy subsoil, is greater than on a siliceous sandy soil incumbent

on clay; but the nutritive powers of the herbage produced on the sandy soil is greater.

Sainfoin grows wild in all the chalky districts in England; but it was first introduced to English farmers as a plant for cultivation from Flanders and France, where it has been long cultivated. Parkinson, in the year 1640, says, that it is "generally known to be a singular food for cattle, causing them to give store of milk."—Worlidge, in his *Mystery of Husbandry*, &c. (1681), treats of sainfoin at large: "In Wiltshire, in several places," says he, "there are precedents of sainfoin that has been there twenty years growing on poor land, and has so far improved the same, that from a noble per acre, twenty acres together have been certainly worth thirty shillings per acre, and yet continues in good proof."—These extracts show the high opinion which was entertained of this plant above one hundred years ago; but this was, no doubt, in a great measure owing to the small number of plants then known for sowing in the farm.

The experiments that have here been made on this plant were confined to a clayey loam and a light siliceous soil. Upon these it was evidently inferior to the broad-leaved and perennial red clover; but on chalky and gravelly soils there have been abundant proofs of the superior value of sainfoin. After the ample details of the uses and cultivation of sainfoin, given in Mr. Young's *Annals*, it will be difficult to add any thing new. It is a perennial plant, and produces but little herbage the first year, and on that account should not be sown on land that is intended to remain only two years under grass. In Mr. Young's *Annals* we are informed, that sainfoin is allowed on all hands to be an admirable improvement on limestone rocks and chalk downs, which, in order to be cultivated to the greatest advantage, should be in this course, with no more arable than is necessary for the change. Thus, if sainfoin last sixteen years, as it certainly will if properly managed, then sixteen parts of the down should be sainfoin, and as many more parts as there are years necessary for tillage, before the ground should be sowed with it again: suppose this period to be five years, the portions would then be 16 sainfoin, 1 sainfoin pared and burnt

and under turnips, 1 barley or oats, 1 clover, 1 wheat, 1 turnips, 1 barley or oats, and with this crop sainfoin sown again = 22. In another part we are informed that sainfoin is also a great improvement in thin, loose, dry, sandy loams, upon marl or chalk bottoms.

Thin soils that wear out, or tire of clover, are laid down to great advantage with it, will last twenty years, and pay the farmer as well as his best corn crops.

It flowers about the middle and towards the end of June. The seeds are large, and when sown in wet soils generally burst and rot without vegetating. There is some difference of opinion with respect to the best season for sowing; according to several trials that I have made, the middle or end of April is the most certain; but when sown in the autumn, unless the soil be favourable, many of the plants are lost during the winter: should circumstances prove otherwise, the autumn sowing will be found the most advantageous, as it affords nearly a full crop in the ensuing season.

It was before observed, that dry thin sandy pastures are the least capable of improvement, from the defect in the constitution of the soil, which arises from the want of clay and marl. The process of paring and burning, which is so efficacious in converting bogs and rough tenacious clays, is found to injure thin sands; yet, without this process of burning the surface, the crops that follow the ordinary mode of breaking up such soils by the plough only are devoured by insects at the roots, and seldom repay the expense of labour.

The comparative disadvantages which attend the ordinary mode of converting thin sandy pastures into tillage by ploughing only, are found by experience to be far greater than those which result to the soil by the process of burning. Sir Humphry Davy says, that "the process of burning renders the soil less compact, less tenacious, and retentive of moisture;" burning, therefore, increases the natural defects of sandy soils, and lessens the quantity of soluble vegetable matter they contain. It seems probable, however, that the process of burning may be conducted in such a manner as to prevent any diminution of the original quantity of soluble

vegetable matters contained in the soil. For when the parings or turfs are submitted to the fire, they should only be burnt till the ashes are black, and will then contain carbonaceous matter, which will be found to afford more soluble vegetable matter than the soil originally contained. But when the parings are burnt till the ashes are red or white, the carbonaceous matter is destroyed, and the ashes that remain will be found to consist of oxides and saline matters of little value to such soils. With respect to tenacious clayey soils, the case is directly the reverse: these cannot be too much burnt by the ordinary process of burning, as the object here is not so much to destroy insects and the seeds of noxious plants, as to correct the texture of the soil, by rendering it more friable, and less tenacious or retentive of moisture.

It is evident that the application of clay or marl, and vegetable manure, even in small quantities, will compensate the soil for the greater division of its parts and loss of decomposing vegetable matter, let the process of burning be conducted in what manner it may; but there are no remedies at present known, for the prevention or even palliation of the ravages of the wire-worm, grubs, and other voracious insects with which these soils generally abound, except that of burning, which, when properly effected, experience has proved to be effectual to the destruction of a one year's brood.

In Scotland and in England I have witnessed the practice of converting rough pastures, containing heath, furze, and coarse grasses, by first burning the plants on the surface while growing, and then ploughing the land for a course of crops. By this, it invariably happened that the land soon became stocked with its original unprofitable plants, as their seeds and roots were securely preserved in the turf while the plants themselves were burning.

In the Essays published by the Board of Agriculture, a variety of facts are brought forward, which go to prove the great increase of value which these pastures are capable of receiving by a proper mode of converting them into tillage.

Mr. Stephen Kershaw states, in his experiments, the increase of value in thin-skinned warren, when converted into

tillage by previously paring and burning, to be from thirteen pence per acre, the original value, to six or eight shillings per acre.

Mr. Wright, of Pickworth, after describing several failures in attempting to convert "a tract of poor light barren heath by the ordinary mode of breaking up with the plough, states the complete success which attended his endeavours on another tract of the same soil by paring and burning." This ground, Mr. Wright says, "produced an excellent quality of turnips, value 2*l.* 10*s.* per acre." "I afterwards," continues he, "sowed with barley on one ploughing in March; the crop was estimated at five quarters per acre throughout the piece; clearing to me as much in one year, as it would have done in pasturage, in its original state, in a century."—Mr. Wright recommends the following course of crops:—First year, pare and burn, and sow with turnips; second year, barley; immediately after the barley crop plough once, and harrow in winter tares, to be mown for soiling stock of all kinds on the same ground, which may be begun about the third week of May, and continue till the seed in the pod is nearly ripe, perhaps in July; what then remains unconsumed may be made into excellent hay. After this, on one ploughing to sow turnips, with or without manuring. After the turnips, barley with grass-seeds, either to remain one, or many years.

Mr. Legard, of Gratton, observes, that paring and burning, when regard is had to subsequent cropping, is advantageous, because it generally ensures a crop of turnips, the foundation of all good husbandry; and in light soils, the advantage of eating the turnip crop upon the land is very great, and should therefore be invariably practised.

Other statements, equally satisfactory, might be brought forward, but they all agree in principle—to break up dry rough sandy pastures by paring and burning; white crops seldom, at the most one white to two green crops. In the preparation of the land for these crops, the scarifier should be frequently employed instead of the plough, as the frequent turning up of such soils becomes more injurious than beneficial.

From the foregoing series of facts and observations, respecting the different grasses and other plants which compose the produce of dry upland pastures, it may fairly be inferred, that these plants are not susceptible of that degree of improvement by cultivation which would fit them for the support of the larger domestic animals. Sheep may be considered the only stock that can be profitably maintained on such pastures. Still, however, their natural state may be much improved by frequent top-dressings with manure or compost, and, at the same time, by sowing the seeds of the grasses which will be mentioned hereafter. The roller should be often used; the inferior grasses should not be suffered to perfect or shed their seeds; and the pasture should be closely cropped. By persevering in this mode of treatment, a superior pasture would soon be obtained.

But these improvements, effected on poor siliceous sandy pastures by the above treatment, will be found only temporary; and, as soon as the means are suspended, the pasture will return again to its former inferior state; this kind of soil being of a nature that soon exhausts the manure applied to it, whether on the surface as a top-dressing, or when ploughed in the land. It will be found absolutely necessary to change first the nature of the soil, by the application of clay or marl; and the superior grasses will then keep possession of the soil, even under indifferent management. There will be much less occasion for manure, and the quantity applied will have double the effect. The land, by this means, is improved permanently. It is much to be lamented, that pastures of this nature are often broken up, undergo a course of crops, and are again returned to grass, without any change being made in the nature of the soil. If marl be often out of reach, clay seldom is, as this earth is generally found under sand, or in its neighbourhood. Before clay, marl, or any ingredient that effects a permanent change in the nature of a soil, be applied, the nature of the soil, and the ingredient, should first be ascertained by chemical analysis; and the exact quantity of the ingredient necessary to effect the desired change in the nature of the soil, will by this be accurately determined. Without this,

the operation will be performed in the dark, and consequently with less certain success. If the reader will look back to the observations on soils, he will find some hints on this important point.

Mr. Taunton in his valuable observations on down grasses, states, that the principal strata which afford downs, are first, and most extensively, the chalk, including the wolds in Yorkshire; secondly, in order of succession, the green and brown sand; though these sometimes degenerate into such acerbity, that the heath (*erica vulgaris*, *erica tetralix*, et *erica cinerea*) is abundant, and they therefore form an exception to the general character of downs, whose produce should principally consist of the natural grasses, and which circumstance distinguishes downs, from heaths properly so called: next the oolites or calcareous free-stones, upon which the wolds of Gloucestershire are found: next the mountain lime-stone: and lastly, certain elevated portions of the killas, or slate. All these downs unite in a few general characteristics. The soil is generally thin, dry, light, and porous: from its elevation it is also usually cold, and backward of growth. In consequence of being continually and perfectly ventilated, these pastures are particularly healthy for sheep: by reason of their not being naturally rich, though for the most part easy to work, they are also better adapted for the alternate husbandry, including turnips, than they are for meadow, or pasture for heavy beasts: there are, however, some few parts where either a cap of strong soil left on the summits, or a greater depth of alluvial soil washed together into hollows, throws out a pasturage so strong that a cow can obtain a tolerable bite, and such parts obtain the honourable pre-eminence of being called cow-leazes. The upper soil of these tracts is usually, in a principal degree, calcareous, with a greater or less mixture of siliceous sand, and some portion of argillaceous matter. In some spots the argil, in some the silex, in some the calcareous matter, predominates. The natural grasses which generally abound in these downs are of small bulk, but they are wholesome and palatable, particularly to sheep. Where there is a tolerable portion of argil, we find the cock's-foot (*dactylis*

glomerata), yellow oat-grass (*avena flavescens*), crested dog's-tail (*cynosurus cristatus*), hard fescue (*festuca duriuscula*), smooth-stalked meadow-grass (*poa pratensis*), and perennial ray-grass (*lolium perenne*), most prevalent, but not to the exclusion of others. Where the siliceous sand is most abundant, the meadow fescue (*festuca pratensis*), Welch fescue (*festuca Cambrica*), sweet-scented vernal-grass (*anthoxanthum odoratum*), woolly oat-grass (*avena pubescens*), purple fescue-grass (*festuca rubra*), early hair-grass (*aira præcox*), crested hair-grass (*aira cristata*), common bent grass (*agrostis vulgaris*), upright bent grass (*agrostis stricta*), bundled-leaved bent (*agrostis fascicularis*), common quaking-grass (*briza media*), and flat-stalked meadow-grass (*poa compressa*), are most prevalent. Where the calcareous matter predominates, we find, in the greatest abundance, sheep's fescue (*festuca ovina*), meadow-oat-grass (*avena pratensis*), upright brome-grass (*bromus erectus*), pinnate brome (*bromus pinnatus*), knee-jointed meadow cat's-tail (*phleum nodosum*), and (*phleum pratense*), varietas minor. Unless there be in the soil some proportion of argil, neither the *avena flavescens*, *dactylis glomerata*, nor *cynosurus cristatus*, will grow. Mixed with the preceding natural grasses, over these downs, are to be found some species of *scabiosa*, *orchis*, *carex*, *trifolium*, *plantago*, *lotus*, *ornithopus*, *poterium*, *anthyllis*, *hedysarum*, *medicago*, *campanula*, and *hieracium*. Mr. Taunton expresses little doubt that in a sandy chalk down, with a tolerable depth of soil, and with such a proportion of argil as not to starve the cock's-foot, the union of cock's-foot, meadow-fescue, narrow-leaved brome-grass, yellow oat-grass, upright brome-grass, barley-like fescue, common quaking-grass, downy oat-grass, and meadow oat-grass, would afford a permanent crop of a ton of hay per acre, per annum.

Of the different grasses natural to dry siliceous sandy soils that have been submitted to experiment, and mentioned in the foregoing series, the sheep's fescue (*festuca ovina*), flexuose hair-grass (*aira flexuosa*), long-awned sheep's fescue (*festuca ovina hordeiformis*), common bent-grass (*agrostis vulgaris*), flat-stalked meadow-grass (*poa compressa*), and

common bird's-foot trefoil (*lotus corniculatus*), prove to be the best. For dry calcareous soils, on chalky subsoils, the meadow oat-grass (*avena pratensis*), upright flat-stalked meadow-grass (*poa compressa*), crested brome-grass (*bromus cristatus*), will be found the most valuable, if no alteration be made in the nature of the soil.

It has already been observed, that the value of these grasses, even when cultivated in the best manner, are only adapted for the maintenance of sheep; and to introduce the superior pasture grasses on such soils, the previous application of clay or marl is absolutely necessary. When this important point has been effected, to obtain the most valuable sward the soil is capable of producing, the seeds of the following grasses should be sown; and experience will prove, that, under such circumstances, they are the best for this purpose.

Barley-like sheep's fescue (<i>festuca ovina hor-</i> <i>deiformis</i>)	3 pecks.
Cock's-foot grass (<i>dactylis glomerata</i>).....	3
Crested dog's-tail grass (<i>cynosurus cristatus</i>)..	1
Yellow oat-grass (<i>avena flavescens</i>)	2
Ray-grass (<i>lolium perenne</i>)	1
Flat-stalked meadow-grass (<i>poa compressa</i>) .	1
Various-leaved fescue (<i>festuca heterophylla</i>)..	1½
Hard fescue (<i>festuca duriuscula</i>).....	2
Lesser bird's-foot trefoil (<i>lotus corniculatus</i>) ..	1 lb.
White clover (<i>trifolium repens</i>)	3

From a variety of experiments that I have made on a small scale, with a view to ascertain the quantity of seed that would produce the best sward in the shortest space of time, I feel convinced, that any quantity less than four or five bushels per acre of the above mixture should not be used under the circumstances of soil now described.

Barley proves always less injurious to the grasses, when sown with them, than any other of the white grain crops. The nutritive matter of barley contains more sugar and proportionally less gluten or albumen, than any other species of corn.

The defect of sandy soils in germinating seeds is clearly owing to the sudden deprivation of moisture which they suffer when a course of dry weather commences just before, after, or at the time the seed begins to vegetate. For when sandy dry soils are duly supplied with moisture, seeds sown on such, sooner vegetate than on any other kind of soil, whether of a richer or more tenacious nature.

The manner of growth of tares offers a remedy for the defect of white grain, or upright growing crops. The stems of tares spread out and shade the surface of the soil from the effects of the sun. But, unless tares are sown very thin, they will be found to destroy the seedling grasses, by excluding the air. In every instance, however, where the seeds of annuals are sown with the perennial grass seeds, it should be remembered, that every plant of these occupies a space, to the detriment of the expected sward; and the results of all my experiments perfectly agree in confirming the opinion, that for *permanent* pasture, the grasses sown should be free from any admixture of annual, or white grain crops.

The results of all the experiments on light sandy soils, tend to confirm the opinion before expressed, respecting the superiority of depasturing or mowing seedling grasses the first year. Oxen are liable to poach the surface; and horses and sheep weaken the seedling plants, by cropping too near the roots. Sheep are evidently the least hurtful. By frequently rolling the surface, and mowing the produce, the young plants establish themselves better in the ground, and all of the plants raised are preserved; but by leaving the plants to perfect their seed the first year, and excluding cattle, the young plants are deprived of the benefit of the manure supplied by the sheep, which, at this stage of the growth of seedling grasses, is more particularly valuable on a soil of this nature than on rich ancient pasture land; as the roller, when used judiciously, presses the droppings into the surface of the ground, and brings the manure in contact with the fibrous roots of the plants. It is evident, however, that all the benefits accruing to the plants from depasturing the first year, may be supplied by a top-dressing in the

autumn or spring, and a liberal use of the roller, when the ground is in a suitable state to benefit by it. But suffering the seedling plants to perfect their seed before the crop is collected, is doubtless not the best practice: in all my experiments, the results were decidedly in favour of this opinion. A top-dressing should never be applied without sowing some of the seeds along with it; once sowing will never be found efficient to form the most valuable sward in the shortest space of time, on a light dry sandy soil.

Should the mode of depasturing, instead of mowing the first year's crop, be still preferred in any case, I may be permitted once more to remark, that nothing weakens or retards the growth of grasses so much, as cropping them close at the time their first tender shoots appear in the spring. From various trials it appeared, that close cropping the produce of this soil early in the spring, and late in autumn, was much less injurious to its old sward than to seedling grasses. When a given space of the same species of grass was cut close to the roots towards the end of March, and another space left uncropped till the last week in April, the produce of each space being afterwards taken at three different cuttings, the produce of the space that was left uncropped till the latter end of April, exceeded that of the early-cropped space in the proportion of 3 to 2; in one instance, during a dry summer, the last cropped space afforded a produce superior to that of the early cropped space, as 2 to 1. In all these trials, the produce of the early space consisted of four crops, and that of the latter three. It appears, therefore, that no stock should be admitted to seedling grasses, till after the time of their coming into flower.

CHAPTER IV.

OF THE GRASSES WHICH NATURALLY GROW IN MOIST SOILS, OR
IN BOGS, LANDS THAT ARE PERIODICALLY OVERFLOWN, AND
IRRIGATED MEADOWS.

ALL the superior pasture grasses will thrive under irrigation, provided the water-meadow be properly constructed, that is, if the water be placed perfectly under command, so as to be admitted on the land, and carried off from it at pleasure.

Bogs and lands that are periodically overflown, on which the water stagnates from the want of drains, support few grasses of any value to the agriculturist. They are principally the following:—Marsh-bent (*agrostis palustris*), awnless brown-bent (*agrostis canina*, vel *trichodium caninum*, var. *mutica*), awned creeping-bent (*agrostis stolonifera aristata*), smaller-leaved creeping-bent (*agrostis stolonifera angustifolia*), creeping-rooted bent (*agrostis repens*), white bent (*agrostis alba*), flote fescue (*glyceria fluitans*), tall fescue (*festuca elatior*), turfy hair-grass (*aira cæspitosa*), knee-jointed foxtail grass (*alopecurus geniculatus*), water hair-grass (*aira aquatica*), water meadow-grass (*poa aquatica*), long-leaved cotton grass (*erriophorum polystachion*), sheathed cotton-grass (*erriophorum vaginatum*).

The above grasses, however, constitute but a small portion of the produce of marshy ground. The following plants compose the bulk of produce:—Different species of rushes (*juncus*), sedges (*carex*), rush-grasses (*schænus*), club-rushes (*cyperus*), cat's-tail rushes (*typha*), bur-weeds (*sparganium*). Of all these plants, as far as my observations have extended, two or three species of *juncus* only are eaten by cattle. Mr. Taunton indeed says, that he has observed cattle crop some of the species of *carex*. The natural or proper grasses

produced on these stagnant lands, are of a very inferior value. The water meadow-grass seems the most valuable, as will appear by the following details of experiments made upon them.

To the indigenous grasses natural to marshy and sour clayey lands, mentioned in the following series of specimens, I have added such foreign grasses as may be classed with them.

AGROSTIS canina, var. *mutica*. Awnless variety of Brown-bent.

Specific character: Panicle branches subdivided, roughish; corolla of one husk awnless.

Experiments.—At the time of flowering, the produce from a bog soil is 5,445 lbs. per acre.

It will have been remarked, from the perusal of the foregoing statements, that the stoloniferous grasses afford more nutritive matter at the time, and after the seed is ripe, than at the time of flowering. The decumbent stems, or runners, of this grass, furnished with tufts of leaves at the joints, illustrate, in some measure, the meaning of the term stoloniferous. Sir Humphry Davy says, that the concrete sap stored up in the joints of these grasses renders them a good food, even in winter. The weight of nutritive matter contained in this grass, at the time the seed is ripe, is superior to that afforded at the time it is in flower, in the proportion of 7 to 10.

It is the most common grass on deep bogs, even where they are subject to be under water for six months in the year. It is a diminutive plant, very unlike the produce of such soils; the leaves seldom attain to more than two or three inches in length. Hares crop the foliage in the spring. The smallness of the produce, even when cultivated under the most favourable circumstances, affords a sufficient proof of its unworthiness to be regarded by the farmer in any other light than that of a weed which indicates a soil capable of being improved, so as to produce the most valuable grasses by artificial irrigation. It may be propagated to any extent



Agrostis Alba

by seeds, or by planting the stolones, or decumbent-rooting shoots.

Flowers in the second and third weeks of July, and ripens the seed about the middle of August.

AGROSTIS *alba*. White Bent.

Specific character: Panicle spreading, meagre, branches roughish; culms decumbent; root creeping. *Fig. 1.* Floret, magnified. 2. Inner husks and germen.

The creeping root and meagre produce of the *agrostis alba*, and the fibrous root and comparatively great produce of the *a. stolonifera*, are agricultural characters of distinction of the highest importance; and although the writer of this perfectly agrees in the opinion, that the essential botanical characters of distinction afforded by these grasses are insufficient to constitute them distinct species, yet the very opposite external habits and agricultural merits of these grasses, and which have been fully proved to be permanent, induce me, but with the greatest deference, to retain those names of these grasses nearly the same as they are given in the original of these pages. That our *agrostis stolonifera* is the *a. alba* of Linnæus, is clearly proved by Sir James Edward Smith in his English Flora. The error seems to have originated in Withering, and from that authority propagated with ready facility among practical men; the term *stolonifera* being so appropriate a name to that grass, while the term *alba*, on the other hand, seemed equally inappropriate, as conveying the idea of a property existing in the plant nowhere apparent, but when applied to the creeping-rooted *agrostis*, as described by Withering and others under the name of *alba*, might very properly allude to the white creeping roots of that species.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey soil is 8,167 lbs. per acre.

This grass is late, unproductive, and contains but little nutritive matter. Its creeping roots greatly exhaust the soil; in this variety they are smaller than in the other

varieties, but equally difficult to extirpate when once in possession of tenacious clays. The next following species (*agrostis repens*), is more troublesome as a weed, though less productive. Neither of these plants produces stolones or runners, like the varieties of the *agrostis stolonifera*; sometimes, indeed, a few slender runners are found, but they seldom strike root at the joints. The creeping roots abundantly supply this defect in the plant for its propagation, as they creep under the surface, and send up at intervals numerous young shoots. This property of the roots is the best character of distinction for the purpose of the agriculturist, as it may be found at any season or stage of growth of the plant.

Flowers in the first week of August, and the seed is ripe about the beginning of September.

AGROSTIS repens. Creeping-rooted Bent, White Bent.

Specific character: Panicle scattered; branches bare at the base; florets few; calyx inner valve smooth; root creeping.

Obs.—The difference between this and the preceding grass is, perhaps, too little to constitute them distinct species; the culms of the former are decumbent; in this grass they are upright, and the root is more powerfully creeping. It is later in coming into flower and in perfecting its seed.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 6,125 lbs. per acre.

Though a later growing grass, it is less productive than the preceding. It is subject to the rust, and a peculiar disease which dries up the extremities of the leaves, and gives it an unsightly appearance. Simple ploughing will be found ineffectual to root out this weed in clayey soils. It will be found ultimately the cheapest and most expeditious mode of extirpating it to follow the plough and fork out the roots. Burning, under such circumstances of soil, would doubtless be highly beneficial, but the roots of this couch-



Agrostis Stolonifera Aristata

grass penetrate so deep that a considerable part of them would escape; and the least particle of the root soon produces a plant.

Flowers in the second week of August, and the seed is ripe about the latter end of September.

AGROSTIS stolonifera aristata. Awned Creeping Bent.

Fig. 1. Calyx. 2. Corolla.

Obs.—The first knowledge I had of this variety was from the Duke of Bedford, who pointed it out on Priesley Moor. I have since found it common on peaty moors. It can scarcely be distinguished from the *agr. stolonifera latifolia* without examining it in the hand. The runners or stolones extend to a great length; they are of a brighter reddish colour than those of the *latifolia*, and every part of the plant is rougher. From these few marks of distinction this variety may have been overlooked, as I find no mention made of it in the botanical works to which I have had access.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a bog soil is 8,848 lbs. per acre.

The weight of nutritive matter in which the crop taken in December exceeds that of the crop when the grass is in flower, in the proportion nearly of 10 to 13, is 70 lbs.

This variety of creeping bent is therefore greatly inferior to the larger-leaved variety (*agrostis stolonifera latifolia*), or fiorin; for the weight of nutritive matter per acre afforded by the *latifolia* is two-thirds greater than that of the awned variety. Cattle appear to eat this grass in common with the rough-stalked meadow-grass and meadow foxtail-grass.

It flowers about a week later than the fiorin, but the seed is ripe about the same time.

AGROSTIS stolonifera angustifolia. Smaller-leaved Creeping Bent.

Var. 3.—Panicle densely crowded with florets; florets small; inner valve of the calyx smooth, the outer

serrulated; corolla without any rudiment of an awn.

Obs.—This is the most common variety of the creeping bent on damp tenacious clayey soils, and in moist woods. It may readily be distinguished from the other varieties, by its small, oblong, crowded panicle of a whitish colour. The stolones are closely pressed to the ground, and are almost covered by the leaves, which are more numerous, and shorter than in any of the other varieties of this grass. The joints are small, of a slight brown colour.

Native of Britain. Root perennial.

Experiments.—At the time the seed is ripe, the produce from a bog soil is 16,335 lbs. per acre.

The *agrostis stolonifera latifolia*, mown in December, afforded of nutritive matter 1,435 lbs.

The *agrostis stolonifera angustifolia*, mown at the same time, afforded only 930 lbs.

Which shows that the value of the variety *latifolia* exceeds, in December, that of the *angustifolia* in the proportion nearly of 11 to 7.

From the above details it is evident this common variety stands next in value to the larger-leaved variety of creeping bent. It appeared from all the observations I could make on this grass when growing in natural pastures, to be entirely neglected by cattle while any of the superior pasture grasses presented a sufficiency for a bite. Though the temporary acceptance or rejection of a particular sort of food by cattle will be found a fallacious criterion of its merit or comparative value, nevertheless, in instances like the present, where the plant possesses no superior quality otherwise, to recommend it, the dislike of cattle to partake of it adds greatly to the demerits of the plant.

Flowers in the second and third weeks of July, and ripens the seed about the end of August.

AGROSTIS *palustris*. Marsh Bent.

Specific character: Panicle loose when in flower, spike-like



Agrostis Stolonifera Angustifolia

when the seed is perfected; calyx-valves equal, the outer only serrulated, larger valve of the corolla with a minute straight awn fixed above its middle, and reaching to its point, obsolete.

Experiments.—At the time of flowering, the produce from a bog soil is 10,209 lbs. per acre.

This grass is properly a subaquatic. It will grow on tenacious clays, but it seems only to thrive in very moist soils, or in such as are for the most part covered with water. In moist woods it is more frequent than any other of the creeping-stemmed bent grasses; here the culms often attain to five feet in height, when supported by bushes.

The above details show the inferior nature of this grass, compared to the larger, and even to the lesser-leaved varieties of the *agrostis stolonifera*. It cannot, therefore, as yet be considered in any other light than a weed that chokes up drains and underwood.

Flowers about the second week of July, and the seed is ripe about the middle and towards the end of August.

GLYCERIA.—*Generic character*: Corolla awnless, cylindrical furrowed, ribbed abrupt, not keeled: seed loose, cylindrical oblong.

Glyceria fluitans. Floating Sweet-grass.

Specific character: Panicle oblong, branched, divaricating; spikelets close pressed; florets numerous, obtuse, seven-ribbed, with short intermediate ribs at the base; nectary obtuse, tumid.

Obs.—This grass has sometimes been mistaken for the *agrostis stolonifera* (fiorin). When in flower there is no difficulty in distinguishing them, the number of florets in each calyx being from five to eleven; in fiorin only one. The leaves are much broader, flat, and perfectly smooth. By simply drawing the finger down the leaves of the fiorin they will be found sensibly rough to the feel, but those of the floating sweet-grass perfectly smooth; by which means the two grasses may be distinguished at any stage of growth.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a strong tenacious clay is 13,612 lbs. per acre.

The above produce was taken from grass that had occupied the ground four years, during which time it had increased every year; it therefore appears capable of being cultivated as a permanent pasture grass, which is contrary to what has been supposed of the fete fescue. Some writers on the subject of grasses inform us, that kine and hogs are fond of this grass, and that cows, in the spring, are frequently enticed into bogs, by endeavouring to get at the young shoots, which appear earlier than most other grasses. The result of my observations lead me to believe, that when cattle eat this grass it is more through wantonness than any particular relish they have for it. On a bog, where this grass was in much abundance, black cattle only cropped the extremities of the leaves, while the foliage of the *agrostis stolonifera aristata*, *poa trivialis*, and *alopecurus pratensis*, which grew in company with it, were closely eaten down. Birds are fond of the seeds, and generally strip the panicle ere the seeds are all perfected. Schreber informs us, that it is cultivated in several parts of Germany for the sake of the seeds, which are esteemed a delicacy in soups and gruels. When ground into meal, they make bread very little inferior to that from wheat. The bran is given to horses that have the worms, but they must be kept from water some hours afterwards. Fish, particularly trout, are said to be fond of the seeds. The seed will not vegetate unless kept very moist; indeed I never could obtain any plants from the seed except when sown in mud: when raised in this manner, and transplanted on a tenacious clay, the plants thrive very well, and on the fourth year afforded the produce above stated.

Flowers from the first or second week of July, till the end of summer.

AIRA aquatica. Water Hair-grass.

Specific character: Panicle expanding; florets without awns, smooth, longer than the calyx; husks obtuse.



Aira Cæspitosa.

Obs. — Culms seldom more than a foot high, with two or three joints, never more. The leaves are shorter than those of the preceding grass (*glyceria fluitans*), and more rounded at the point. When in flower they cannot be mistaken for each other: the hair-grass has only two flowers in each calyx; the flote sweet-grass from five to eleven.

Experiments. — At the time of flowering, the produce from mud covered permanently with running water is 10,890 lbs. per acre.

This plant is an aquatic, at least I never could preserve it out of water. It is found naturally growing in the mud of standing pools, or running waters. It is therefore unfit for cultivation.

Flowers in the second and third weeks of July. Root perennial and creeping.

AIRA cæspitosa. Turfy Hair-grass, Hassock-grass.

Specific character: Panicle spreading; florets about the length of the calyx, abrupt, hairy at the base; one of them on a hairy stalk; awn short, from the bottom of the outer valve; leaves flat. — *Fig.* 1. A single floret, magnified. 2. Calyx and included florets.

Obs. — Root fibrous; panicle large, of a fine purple silky appearance; root leaves forming dense tufts, extremely rough; the edges so sharp as to cut the finger when passed between them; culms from a foot and a half to three feet high; two, seldom or never three flowers in each calyx; hairy at the base, the lowermost one sitting.

Experiments. — At the time the seed is ripe, the produce from a strong tenacious clay is 10,209 lbs. per acre.

Experience proves the innutritious nature of this grass; but even if it had greater nutritive powers, the extreme coarseness of the foliage would render it unfit for cultivation. Cattle sometimes crop the ends of the young leaves, but in all the instances that have come under my observation, it appeared to be from supreme necessity. The only point to

be considered here, therefore, is how to overcome or destroy it on soils where it has got possession. It delights in moist clayey soils where the water stagnates; but is found in almost every kind of soil, from the dry sandy heath to the bog. It forms dense tufts in pastures very disagreeable to the sight, which are termed hassocks, bulls' faces, &c., by farmers. It is a most difficult plant to extirpate when in considerable quantity. Some persons, to get rid of it, dig up the tufts, and fill up the holes with lime compost: this, no doubt, would answer the end, at least for a few years, if all the roots were destroyed; but this is never the case,—a circle of roots is left which in one or two seasons produce larger hassocks than before; and besides, when the hassocks are numerous, the expense attending this process is considerable. Others depend on occasional mowings to keep the hassocks under; but this is productive of little good, particularly if the mowing of the tufts be deferred till the autumn, which, I believe, is the common practice. I have found no treatment weaken or retard the growth of grass so much as cutting it closely before and soon after the first tender shoots appear in the spring. On the contrary, when left uncut till the flowers are formed, or the seed becomes ripe, mowing then encourages the growth of the plant, and a great increase and activity of the roots ensue. In this palliative remedy, therefore, the principal efforts should be made to keep the plant close to the roots in the early part of the spring, and till Midsummer.

But the only effectual and most profitable mode of extirpating this grass is by first paring and burning the surface of the land, and by making proper drains, to correct, as much as possible, the tenacious nature of the soil: in this case surface drains are as necessary as those termed hollow. Sand should likewise be applied during the course of crops taken previous to returning the land again to permanent pasture,—if such should be desirable from its local situation: as that, for instance, of a park.

Flowers about the third week of July, and the seed is ripe towards the end of August.

ALOPECURUS geniculatus. Knee-jointed Foxtail-grass.

Specific character: Culms ascending, bent at the joints; panicle spike-like, cylindrical, obtuse; husks of the calyx united at the base, obtuse, somewhat woolly; apex of the corolla minutely notched.

Obs.—There are two varieties of this species of fox-tail grass; the present, which is by far the most common, is distinguished from the other by its fibrous root and greater size; the less common variety has a bulbous root. The *alopecurus bulbosus* may be distinguished from the bulbous-rooted variety of the knee-jointed species by its upright culms, which want the knee-jointed form so conspicuous in the culms of the former. The anthers are at first of a purple colour, but afterwards become ferruginous.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a rich moist alluvial soil is 6,806 lbs. per acre.

It grows common in surface-drains, and at the entrance of cattle-ponds, particularly where the soil is clayey. It does not appear to be eaten with much relish by either cows, horses, or sheep. Its nutritive powers are not considerable, and its sub-aquatic natural place of growth excludes any recommendation of it for cultivation.

Flowers in the first week of June, and during the summer.

GLYCERIA aquatica. Reedy Sweet-grass, or *Poa aquatica*, Water Meadow-grass.

Specific character: Panicle erect, repeatedly branched, spreading; florets numerous, obtuse, with seven ribs; nectary cloven, acute. *Fig.* 1. Spikelet of flowers magnified. 2. The Germen.

Obs.—The creeping roots terminate in jointed culms; fibrous roots numerous. Culms very high, from three to six feet. Leaves straight, broad, smooth on every part except the edges and keel; sheaths a little com-

pressed, striated, smooth ; scales short, obtuse. Panicle very large, upright ; branches pressed towards the main stalk before and after flowering.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a strong tenacious clay is 126,596 lbs. per acre.

This grass is common on the banks of rivers, and frequent on the margin of standing pools. On the banks and little islands of the Thames, where it is generally mown twice in the year for hay, it affords abundant crops of valuable winter fodder. Mr. Curtis informs us, that in flat countries, which do not admit of being sufficiently drained, it is almost the only grass for hay and pasturage. In the fens of Cambridgeshire and Lincolshire, &c. immense tracts, that used to be overflowed and produce useless aquatic plants, and still retain much moisture, though drained by mills, are covered with this grass : which not only affords rich pasturage in summer, but forms the chief part of their winter fodder. Its powerful creeping roots make it a dangerous and troublesome plant in ditches, where, with other aquatic plants, it soon chokes them up. In the Isle of Ely they cleanse the ditches of these weeds by an instrument called a *bear* ; which is an iron roller, with a number of pieces of iron, like small spades, fixed in it. This is drawn up and down the river by horses walking along the bank, and tears up the plants by the roots, which float, and are carried down the stream. In the Bath Agricultural Papers, the water meadow-grass, we are informed, “in its native soil, the fens of the Isle of Ely, grows to the height of six feet. It is usually cut when about four feet high ; when dry they bind it in sheaves ; it generally undergoes a heat in the rick, which improves it. It is excellent fodder for milch-cows ; horses are not fond of it. The inhabitants there call it fodder, by way of eminence, other kinds of coarse hay being called stover, *i. e.* coarse stuff. It is also called white lead, drying of a white colour.”

The nutritive matter of this grass contains a greater proportion of sugar than exists in any of the superior pasture grasses. I offered a bundle of the grass to a horse that was grazing on a field of white clover ; the animal ate it with

seeming relish, taking a bite of the clover and then another of the *poa aquatica*, alternately, till the whole of it was consumed. It does not grow freely from seed, except when sown in mud. The best manner of propagating it, according to my experience, is by planting the roots, which, from their creeping nature, soon increase the number of plants. The best season for sowing the seeds is in the autumn, as soon as they are ripe. The roots may be planted in the autumn, or spring, with equal success. The Rev. Bartholomew Dacre, of Mosely, has made several experiments on this grass; and the results prove, that it may be cultivated on more elevated situations than has been supposed, and that propagating it by planting the roots is the best mode.

Flowers about the second and third weeks of July, and the seed is ripe about the second week of August.

ERIOPHORUM *angustifolium*. Long-leaved Cotton-grass.

Specific character: Culms almost three-cornered; leaves channelled, three-sided; fruit-stalks smooth.

Obs.—There are three species of cotton-grass, which greatly resemble each other: the *e. triquetrum*, *e. angustifolium*, and *e. polystachion*. The *e. angustifolium* (the species now under consideration), differs from the *triquetrum* in having a thicker and more succulent culm; the leaves longer and broader, with only one nerve of a reddish colour; and the fruit-stalks are smooth. It is distinguished from the *polystachion* by its creeping roots; leaves twice the length; involucre and sheaths smooth, spikelets smaller; fruit-stalks shorter; and the woolly hairs everywhere longer.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a bog soil is 8,167 lbs. per acre.

On bogs and moors where this grass abounds, cattle crop the leaves in the spring; but as soon as the finer kinds of grasses afford them a bite, they neglect it. There are many grasses of superior value, that succeed equally well on this kind of soil. When such lands are capable of being

drained (which is generally the case), it should be effected, and the soil will then carry the superior grasses, as the meadow-fescue, cock's-foot grass, meadow cat's-tail grass, meadow fox-tail grass, rough-stalked meadow-grass, &c. Where draining cannot be economically practised, the surface should be pared and burnt, and afterwards planted with fiorin (*agrostis stolonifera*, var. *latifolia*), or with the water meadow-grass (*poa aquatica*). If the soil be not too wet for the former, or too peaty for the latter, the produce will be found amply to reward the labour of preparing and planting the soil. Mr. Pennant says, that about April, in the Isle of Skye, the farmers turn their cattle during the day-time to this grass, which springs first, and at night drive them into dry ground again.

In Germany, Professor Martyn informs us, and in the more northern parts of Europe, the down has been manufactured into various articles of dress, paper, and wicks for candles. In some parts of Sweden, the peasants stuff their pillows with it, whence it is called "poor man's pillow," but it becomes brittle when dry.

Neither the productive or nutritive powers of this grass appear, from the above details, sufficiently great to recommend it for cultivation. Though it comes into flower in June, it is late in the spring before the foliage attains to any length.

ERIOPHORUM *vaginatum*. Hare's-tail, or Sheathed Cotton-grass.

Specific character: Culms obscurely three-cornered, sheathed; spike oval oblong.

Obs.—Culms erect, smooth, with three or four joints, roundish below, three-cornered above, from six to twelve inches in height. Root-leaves sharp-pointed, streaked on two sides, convex on one side, flat on two sides. Stem-leaves less sharp, upper one with a remarkable inflated sheath. It produces only one spike, which is upright.

Native of Britain. Root perennial, fibrous.

Experiments.—At the time of flowering, the produce from a bog soil is 6,806 lbs. per acre.

The produce and nutritive properties of this grass appear to be very inferior to the preceding species of cotton-grass. The chief property that would give value to it, if its productive powers were greater, is its early growth, being one of the earliest of the British grasses, flowering in April. The foliage is equally early, growing in proportion with the flowering culms; but its produce of latter-math is very inconsiderable. It is more frequent on moors of a drier nature than moist bogs, though it is to be met with on most of them. Sheep are said to be very fond of this grass, but as far as I have had opportunity to observe, they only crop the foliage in the spring, till the finer natural grasses afford them a bite. It offers, therefore, no particular merit to warrant a recommendation for the purposes of the agriculturist.

It flowers about the third week of April, and the seed is ripe about the third week of May.

PHALARIS *arundinaceus*. Reed Canary-grass.

Specific character: Panicle upright, with spreading branches; flowers crowded, unilateral; outer corolla of two bearded valves.

Native of Britain. Perennial.

Experiments.—At the time of flowering, the produce from a black sandy loam incumbent on clay is 27,225 lbs. per acre.

From these details of experiments, it appears that the striped reed canary-grass is much more productive on a tenacious clayey soil than on a rich sandy loam. The striped reed canary-grass has not yet been found in a wild state. It is cultivated in gardens, for the beauty of its striped leaves. The common wild variety, which grows by the sides of rivers and standing pools, wants this distinguishing feature. It grows to a greater height than the striped-leaved variety, and does not appear to be eaten by cattle: but birds are fond of the seeds. There are striped-leaved varieties of the

agrostis alba, and *ductylis glomerata*, in the Woburn collection of grasses, which, for the strength and beauty of the tints in the leaves, are equal, if not superior, to those of the striped-leaved reed-grass.

It comes into flower about the first and second weeks of July, and the seed ripens about the middle of August.

FESTUCA *elator*, var. *sterilis*. Barren-seeded Tall Fescue.

Specific character: Panicle directed on one side, upright; spikelets mostly awned, the outer one cylindric.

Obs.—It greatly resembles the *festuca pratensis*. It is larger in every respect; flowers eight or ten days later. The panicle of the *pratensis* is upright at first, afterwards drooping; while the panicle of the *elator* is drooping at first, and afterwards upright: spikelets of a green and purple colour, cylindric, generally awned; leaves rougher and less pointed than those of the *festuca pratensis*.

Native of Britain. Root perennial, fibrous.

Experiments.—At the time of flowering, the produce from a black rich loam is 51,046 lbs. per acre.

The produce of latter-math is 15,654 lbs. per acre.

The grass, at the time of flowering, affords more nutritive matter than that of the latter-math in the proportion of 5 to 4; but the grass of the latter-math contains more nutritive matter than that at the time the seed is ripe, in the proportion of 4 to 3.

A tenacious clay is, therefore, best fitted for the production of this grass; as, notwithstanding the plentiful supply of manure, the produce from the loam which had the advantages of it scarcely exceeds that from the clay. I know of no grass of this class adapted for clays that holds out such fair promises to repay the farmer. “The garden, farm, and cottage system, for bettering the moral condition of the labouring classes of society,” which has been planned, and is now carrying into execution, by that eminent and benevolent individual, William Allen, Esq., would derive benefit by adopting the culture of this and several other highly productive grasses, in such moist spots of the soil as are pecu-



Festuca Elatior Fertilis.



liarily fitted for the growth of these species, and less fitted for the growth of proper pasture grasses. It is one of the earliest grasses, with regard to the production of foliage early in the spring. It is nutritive, and very productive. It is true, the produce may be denominated coarse when compared to the *festuca pratensis*, *alopecurus pratensis*, and other of the superior grasses; but where is a grass to be found that produces a great weight of crop that is not in some degree coarse? This objection, however, as before observed, may be overcome by reducing the hay to chaff and mixing it with clover-hay. The nutritive matter contains but little bitter extractive or saline matter, whereas the clover contains an excess. It does not perfect much good seed, and can only therefore be propagated by parting and planting the roots.

The present variety flowers in the second week of July; the seed is universally, according to all my observations, affected with the disease termed *clavus*, and consequently unfertile.

FESTUCA *elator*, var. *fertilis*. Fertile-seeded Tall Fescue.

Obs.—Differs from the common variety of tall fescue, in having the panicle somewhat drooping; spikelets six-flowered, more ovate and flat; the larger husk of the calyx often awned, and the awn is fixed on the apex more in the manner of that of a *bromus* than a fescue. Leaves smoother, and of a less dark green colour. I found this grass on a moist part of a field belonging to Mr. Westcar, at Creslow, Bucks, growing in company with the barren-seeded variety. *Fig.* 1. Spikelet, magnified. 2. Corolla. 3. Germen, styles, and nectary.

Experiments.—At the time of flowering, the produce from a black sandy loam, incumbent on clay, is 54,450 lbs. per acre.

This grass, which is nearly allied to the common *festuca elator*, perfects an abundance of seed, though not entirely free from diseased portions, and is therefore not liable to the objection which takes so much from the value of that variety.

It is equally early in the produce of foliage, and flowers earlier than the barren tall fescue by eight or ten days; the produce is equally nutritive. For damp soils that cannot conveniently be made sufficiently dry by drains, this would be a most valuable plant, either to be cut for soiling or made into hay, and reduced to chaff as it might be wanted. I have never seen this plant in a wild state; it was first discovered here in the Grass Garden, seemingly introduced by accident. W. P. Taunton, Esq., of London, was kind enough to send me some seeds of a grass which he found growing on a bastard fuller's-earth soil in considerable plenty, in the parish of Kilmersdon, Somerset. I believe this to be the same grass.

Mr. Taunton, who has paid much attention to the subject, conceives that the disease termed *clavus*, which renders the seed of the other variety of tall fescue abortive, may be caused by over-richness of the soil. *Acinula clavus* is a parasite fungus which takes possession of the embryo seeds of grasses. When found on rye it is called ergot; and when used in bread is most dangerous: but used medicinally is a useful drug.

It comes into flower about the beginning of July, and the seed is ripe about the first week in August.

BROMUS littoreus. Sea-side Brome-grass.

Specific character: Panicle branches wide-spreading; spikelets oval-spear-shaped, sometimes awned, from four to five-flowered.

Obs.—It may be only a variety of the *festuca elatior*, but the whole habit of the plant is manifestly different. Native of Germany. Perennial; growing on the banks of the Danube and other rivers.

Experiments.—At the time of flowering, the produce from a clayey loam is 41,518 lbs. per acre.

When compared with the tall fescue, this species of brome is found to be inferior in nutritive properties, and in the quality of the herbage. The leaves are much coarser in every respect. It cannot therefore be recommended for any agricultural purpose.

Flowers about the first and second weeks of July, and ripens the seed in three weeks afterwards.

ELYMUS *Philadelphicus*. Philadelphian Lyme-grass.

Specific character: Spike pendulous, open; spikelets villose, six-flowered, the lower ones ternate.

Experiments. — At the time of flowering, the produce from a clayey loam and retentive subsoil is 30,628 lbs. per acre.

In the Hortus Kewensis we are informed, this grass was first introduced into England by the Rt. Hon. Sir J. Banks, Bart., K. B., in 1790, from North America. It is a very productive grass, and with respect to foliage, is rather early in the spring: it contains a considerable quantity of nutritive matter. From the large size it attains, the produce is rank and proportionally coarse, and is unfit for pasture. It appears that for soiling, or hay to be used in the form of chaff, this, and some other of the gigantic grasses, would be profitable plants on soils unfit for the production of the superior pasture grasses, or of corn.

A comparison of the quantity of nutritive matter contained in hay of the best quality, with that contained in an equal weight of the hay made from this grass, will show, nearly, their comparative value.

One pound of hay composed of the best natural grasses contains of nutritive matter 57 dr. One pound of hay composed of the *elymus Philadelphicus* contains of nutritive matter 34 dr. With regard to nutritive powers, therefore, five tons of the hay of this grass are scarcely equal to three tons of that of the superior grasses. But the soil that will produce this grass, and others of the same class, at the rate of six tons per acre, would not produce one-fifth the quantity of the superior grasses; consequently, the adoption of the tall fescue and Philadelphian lyme-grasses, on soils of this description, for the uses now described, might be found a profitable measure.

Flowers in the first and second weeks of July, and suc-

cessively till the end of summer. Seed ripe in about three weeks after the time of flowering.

ELYMUS striatus. Striated Lyme-grass.

Specific character: Spike erect; spikelets two-flowered, fringed; involucre or calyx striated, short.

Obs.—Native of North America. Root perennial; was introduced into this country about 1790.

Experiments.—At the time of flowering, the produce from a clayey loam is 20,418 lbs. per acre.

From these details, therefore, this species is inferior in nutritive powers to the Philadelphian lyme-grass in the proportion of 17 to 16. It is also much later in the production of foliage in the spring, and does not come into flower till after that species has nearly perfected its seed. It cannot, therefore, be recommended for the purposes of the agriculturist.

Flowers about the latter end of July, and ripens the seed in August.

ELYMUS Sibericus. Siberian Lyme-grass.

Specific character: Spike pendulous, like an arch; spikelets longer than the calyx. Native of Siberia. Root, on a moist or clayey soil, biennial; on a sandy soil it continues several years.

Experiments.—At the time of flowering, the produce from a rich sandy soil is 16,335 lbs. per acre.

The produce of this grass is very coarse, and the weight of the crop, therefore, though considerable, is comparatively of no value. It is a native of Siberia, and withstands the effects of the severest continued frost, but not sudden changes from frost to mild weather. It requires to be sown every year, and treated as an annual. It comes into flower the second season, about the second or third week in June, and continues to emit flowering culms till autumn. The seed is ripe in about three weeks after flowering. A light rich siliceous soil appears to be best adapted to its growth. In the



Elymus Arenarius.

Hortus Kewensis it is said to have been cultivated, in 1758, by Mr. Philip Miller.

ELYMUS *hystrix*. Rough Lyme-grass.

Specific character: Spike upright; spikelets without the involucre, spreading.

Native of the Levant. Root perennial.

Experiments. — At the time of flowering, the produce from a rich siliceous sandy loam is 27,225 lbs. per acre.

The harsh, broad, thin, light-green leaves of this species, and likewise of those of the *e. striatus* and *e. Sibericus*, indicate that they are naturally inhabitants of woods or wet shady places, and there is no authority for recommending the rough lyme-grass to the notice of the agriculturist.

It flowers in the second week of July, and ripens the seed in the second week of August.

ELYMUS *arenarius*. Upright Sea Lyme-grass, Starr, or Bent.

Specific character: Spike upright, close; main stalk not winged; calyx lanceolate, the length of the spikelets; leaves spinous-pointed. — *Fig.* 1. Spikelet. 2. Floret. 3. Germen.

Native of Britain. Root perennial.

Experiments. — At the time the seed is ripe, the produce from a clayey loam is 43,560 lbs. per acre.

The nutritive matter afforded by this lyme-grass is remarkable for the large quantity of saccharine matter which it contains, amounting to more than one-third of its weight; this grass may therefore be considered as the sugar-cane of Britain. The saccharine matter must render the hay made from this grass very nutritious, particularly when cut into chaff, and mixed with corn or common hay. Its natural soil (if soil it can be called) are the blowing sands on the sea-coast. The *arundo arenaria*, *poa maritima*, and *festuca rubra*, I found in company with the *elymus arenarius*, on the sands near Skegness, Lincolnshire. The sand-hills on the shore near that place were formed by the *e. arenarius* and

arundo arenaria; the latter, with its tufty habit of growth, formed the summit of the hill, while the broad spreading roots and leaves of the *elymus arenarius* secured the base and sides. These two grasses, when combined, seem admirably adapted by nature for the purpose of forming a barrier to the encroachment of the sea. What sand the *arundo arenaria* arrests and collects about itself, the *elymus arenarius* secures and keeps fast. The culms are produced in small number when cultivated on a clayey loam, or on a sandy soil. This deficiency of culms was even apparent in the plants, when growing in their natural soil. A greater proportion of saccharine matter is afforded by the culms of this grass than by the leaves.

Flowers about the third week in July.

ELYMUS geniculatus. Knee-jointed Lyme-grass.

Specific character : Spike bent perpendicularly downwards, loose; calyx bristle-shaped, spreading, longer than the spikelets; leaves sharp-pointed.

Obs.—A singular habit of this grass is, that the spike, just before flowering, bends down by the assistance of a joint near the foot of the spike-stalk.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a sandy loam is 20,418 lbs. per acre.

The root is powerfully creeping, and the foliage is tough and coarse. The quantity of nutritive matter it affords is not considerable. It seems, therefore, to be but little adapted for useful purposes. Sir J. E. Smith, in the English Botany, informs us, that it was discovered in the salt marshes of Gravesend by Mr. Dickson, and that Mr. Curtis was the first to distinguish it from the *elymus arenarius*,—as it seems even Linnæus had confounded them.

At the time of flowering, the produce of the *elymus arenarius* on a clayey loam is 43,572 lbs. per acre.

This species is greatly superior to the above in produce



Arundo *Arenaria.*

and nutritive properties, but neither appear to have merits sufficient to recommend it for cultivation.

The knee-jointed, or pendulous lyme-grass, flowers in the second week of July. The sea lyme-grass flowers about a week later. The seed is perfected in about three weeks after the time of flowering.

ARUNDO *arenaria*. Sea-reed, Marram, Starr, or Bent.

Specific character: Calyx single-flowered, longer than the corolla; panicle spiked; flowers erect, slightly awned, leaves involute, sharp-pointed.—*Fig.* 1. Calyx. 2. Floret. 3. Germen, styles, and nectary, magnified.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil is 10,890 lbs. per acre.

The nutritive matter of this grass affords a large portion of saccharine matter when compared with the produce, in this respect, of other grasses: the *elymus arenarius*, however, affords about one-third more sugar than the present plant. The quantity of nutritive matter afforded by the *elymus arenarius* is superior to that afforded by the *arundo arenaria*, in the proportion of 4 to 5.

The above details of produce shew that the *arundo arenaria* is unworthy of cultivation as food for cattle, out of the influence of the salt spray. But the habit of the plant in its natural place of growth, the loose sands of the sea-coast, is of great utility, particularly when combined with the *elymus arenarius* (as was before observed when speaking of that species), in binding the sands of the sea-shore, and thereby raising a natural barrier, the most lasting, against the encroachments of the ocean upon the land. So far back as the reign of William III, the important value of the *elymus arenarius* and *arundo arenaria* was so well appreciated as to induce the Scottish Parliament of that period to pass an act for their preservation on the sea-coasts of Scotland. And these provisions were, by the British Parliament, in the reign of George II, followed up by further enactments, extending the operation of the Scottish law to the coasts of England,

and imposing further penalties for its inviolability ; so that it was rendered penal, not only for any individual (without even excepting the lord of the manor) to cut the bent, but for any one to be in possession of any within eight miles of the coast.

SPARTINA juncea. Rush-leaved Cord-grass, or *Dactylis patens.* Spreading Cock's-foot Grass.

Specific character : Spike spreading, flowering a little on one side ; florets bent like an arch ; culm decumbent ; leaves two-rowed, spreading very much ; keel of the calyx rough. Native of North America. Root perennial.

Experiments. — At the time of flowering, the produce from a rich siliceous sandy soil is 33,350 lbs. per acre.

This grass is very late in the production of foliage in the spring, and it does not come into flower till the month of August. The produce, considered as a single crop, is then great, but it is the only one it produces in the season. The nutritive qualities of the herbage are likewise inferior to those of most other kinds of grass. The leaves are remarkable for their length, smoothness of surface, and toughness of fibre.

I submitted a quantity of the leaves to the process used for forming flax by steeping, drying, breaking, &c. The results were favourable, inasmuch as the clean fibre was equal in strength and softness to that of flax, but it was deficient in length ; for though the leaves of the grass were as long as the plants of flax in general, yet a considerable portion of the top, or from the point of the leaf, did not stand the effects of the process. The only advantage that appears would result from this plant affording flax is, that it could be produced on a soil unfit for the growth of flax or the production of corn.

It flowers in the second week of August, and the seed is ripe about the middle of September.

FESTUCA sylvatica. Slender Wood Fescue-grass.

Specific character : Spike nodding ; spikelets distant,

somewhat erect, awned ; awns longer than the husks.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a rich siliceous sandy loam is 20,418 lbs. per acre.

The general appearance of this grass, and that of the next following species, promise but little to reward the labours of the experimentalist. Its natural place of growth is in woods and damp shady places. Oxen, horses, and sheep, refused to eat this grass when offered to them. During deep snows and severe frosts I have observed hares and rabbits crop the extremities of the leaves. It is very subject to be affected with the rust disease at the time of flowering. Birds appear to neglect the seeds till every other resource fails.

Flowers in the second week of July, and the seed is perfected about the first week of August.

FESTUCA *pinnata*. Spiked Heath Fescue-grass.

Specific character: Spike simple, erect, two-ranked ; spikelets a little distant, awned ; awns after flowering a little spreading, shorter than the husks ; root creeping.

Native of Britain. Root perennial, creeping.

Experiments.—At the time of flowering, the produce from a siliceous sandy soil with manure is 20,418 lbs. per acre.

The wing-spiked brome-grass cannot as yet be considered in any other light than as a noxious weed ; for though the weight of produce is considerable, it is neither early, nutritive, nor relished by cattle.

It flowers about the third week of July, and the seed is ripe about the last week in August.

FESTUCA *gigantea*. Tall Fescue-grass.

Specific character: Panicle nodding at top ; spikelets spear-shaped, compressed, naked ; florets from three to six, imbricated ; awns somewhat flexuose, longer than the husks ; leaves naked.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a rich siliceous sandy soil is 27,225 lbs. per acre.

This species is confined to woods in its natural state; but it continues in the soil, and appears to thrive equally well when cultivated in open situations. It is a coarse grass, and but little nutritive, though greatly superior to the *spiked* and wood fescue grasses. The seeds are eaten by birds; and this appears to be the chief use of the plant, its large structure being, apparently, intended to enable it to perfect its seed among bushes, where it would be otherwise choked up.

It flowers in the third week of June, and ripens the seed about the middle and latter end of July.

AGROSTIS *ramosissima*. Lateral-branching Bent-grass.

Specific character: Panicle spike-like, heaped; calyx shorter than the corolla; culms branching at each joint.

Obs.—This is nearly allied to the *agrostis Mexicana*; the culms are taller and more woody, lateral branches more numerous, shorter, and pointing one way; leaves smoother than those of the *a. Mexicana*; panicle more compact, or heaped together, which gives it more the appearance of a spike; calyx shorter than the corolla, with very few hairs at the base, which are long and numerous in the *Mexicana*. Flowers a month later than that species.

Experiments.—At the time of flowering, the produce from a strong clayey loam is 28,586 lbs. per acre.

This is one of the latest flowering grasses. It is remarkable for the number of branches that issue from the joints of the stem; and the woody substance of the culms makes it approach to the nature of a shrub. It affords little herbage till the beginning of summer, and flowers at so late a period of the season, that, excepting once, I have never been able to procure any perfect seed, the frost generally destroying the panicles before the seed is perfected. The herbage

is killed by frost, but the roots suffer nothing from its effects. It is propagated by parting and planting the roots early in the spring, or late in the autumn. The above details show that it is neither productive nor nutritive.

Flowers in the first or second week of October.

TRIODIA *decumbens*. Decumbent Heath-grass.

Generic character: Corolla orbicular, expanded, obscurely ribbed, deeply cloven, with an intermediate point; both valves concave; seed loose, depressed.

Specific character: Panicle nearly simple, contracted, erect; spikelets oval oblong; florets four, their middle tooth shortest; stipula hairy; calyx smooth, root somewhat creeping.

Native of Britain. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 5,445 lbs. per acre.

It is chiefly confined to high wet barren pastures, though sometimes found in those that are dry. On some particular spots among the trees in Woburn Park, it is found growing in company with the *carex axillaris*. It appears to be but little susceptible of improvement by being transplanted to a richer soil; as the produce from a rich black loam scarcely exceeded the above-stated produce from a clayey loam without any manure. It never appeared to be cropped by the deer in the Park. It is late in the production of foliage in the spring, and produces little after-grass: it is not, therefore, to be recommended for cultivation.

It flowers about the third and fourth weeks of July, and the seed is ripe in the middle and towards the latter end of August, according as the soil and season are favourable to its growth.

From the above details it is evident, that if we except one, or at most two species of grass, the whole natural produce of bogs and low-lying stagnant meadows is of little or no value to the possessors. Such lands, however, by the sim-

ple process of forming them into water-meadows, have had their original value, which is generally from one to five shillings, increased to forty, and frequently to sixty shillings per acre. From the magnitude, and the short space of time in which the rise in the value of land is thus permanently effected, the conversion of waste bogs to irrigated meadows may justly be ranked with the very first improvements in this branch of practical agriculture; and were it not from the local nature of the lands in question, when it is considered that in numerous instances, with a spade only, the process may be begun and finished, it may justly perhaps maintain a claim for the first place in improvements of modern agriculture in any branch whatever. At least it appears difficult to find any other improvement in this art that so speedily, permanently, and at so moderate an expense, raises the value of the land to the degree now mentioned. It is hardly possible, I should conceive, to witness one of these wastes converted into a rich fertile meadow in the short compass of two seasons, without feeling a conviction something like this.

In forming a water-meadow, the chief point to be obtained is a perfect command of the water, that it may be admitted on the land, and completely carried off at pleasure; for without this it will be found a vain and useless labour, as none of the valuable species of grass will thrive or even exist in this kind of soil under any other condition.

Lands lying on declivities are seldom converted into water-meadows, from the want of a regular and sufficient supply of water in such situations. Bogs and low marshy grounds are generally, in their natural state, the least profitable of soils, but are capable, by means of irrigation, of having their value increased to a higher degree than any other waste lands.

Water-meadows situated on declivities are termed *catch-work meadows*; and those formed out of bogs and low level land, are styled *flowing meadows*. The last requires the most art and labour in its formation, on account of the difficulty that sometimes occurs in getting a command of the water. This is generally effected by throwing up the land in high ridges,

with deep drains between them. A main carriage is then taken out of the river, at a level sufficiently high to command the tops of the ridges. Along the top of each ridge an open drain or trench is made to communicate with the main water-carriage. These little water-carriages being furnished with moveable *stops* of earth, disperse the water on each side of the ridge, which is received below by the drains, which conduct it to other parts of the same meadow. The point of importance next to that of having a perfect command of water, at least as far as the growth and prosperity of the superior grasses is concerned, is the size of the ridges. Where there is a plentiful supply of water, as from a river, the ridges may be from forty to fifty feet broad, and seventy feet in length; but when the supply of water depends upon a small brook, or upon a reservoir formed by land-drains, thirty feet in width and fifty in length are supposed to be the best dimensions. The height of the ridges seems to be a point of considerable importance. I have invariably observed, that all the superior grasses inhabit the crowns of the ridges, extending generally to eight feet on each side of the water-carriage, and the inferior grasses occupying the lower extremities of the ridges. When the ridges are nearly level, much less water is required to irrigate the land; but unless the subsoil is porous, the produce will be found much inferior to what it would have been had the ridges been raised to a proper height. In all the observations I have made while examining different water-meadows at various periods of the season, the most productive in the superior grasses were those where the ridges were formed thirty-three feet in width and two feet and a half in height, that is, from the level of the furrow to the crown of the ridge. But when the situation is very low and moist, and the soil deep, as in the instance of a peat-bog, or where the subsoil is tenacious, the height of the ridge should be from two to three feet.

From numerous statements published by gentlemen who have made these improvements, the expenses of forming land into water-meadows appear to be from four to twenty pounds per acre,—varying thus according to the local circumstances under which the improvement is made. The

yearly expenses for repairs appear likewise to be from three to nine shillings per acre. The value of such lands, by these means, has been increased from one to twelve shillings (their original value) to forty and sixty shillings per acre. But when connected with a breeding flock of sheep, the advantages derived from these meadows are hardly to be estimated, for they produce a full bite of grass at least three weeks earlier than the common pastures, and that at a season when every other kind of food is scarce.

Irrigated meadows seldom or never require any manure, the water being found sufficient to produce that extreme degree of fertility for which they are remarkable.

Sir H. Davy gives the theory of the effects of water in increasing the fertility of meadows. He says they depend on many causes, some chemical, some mechanical:—"When land has been covered by water in the winter, or in the beginning of spring, the moisture that has penetrated deep into the soil, and even the subsoil, becomes a source of nourishment to the roots of the plant in summer, and prevents those bad effects that often happen in lands in their natural state, from a long continuance of dry weather.

"When water used in irrigation has flowed over a calcareous country, it is generally found impregnated with carbonate of lime; and in this state it tends in many instances to ameliorate the soil.

"Even in cases where the water used for flooding is pure, and free from vegetable or animal substances, it acts by causing the more equable diffusion of the nutritive matter existing in the land; and in very cold seasons it preserves the tender roots and leaves of the grass from being affected by frost.

"Water is of greater specific gravity at 42° Fahrenheit than at 32°, the freezing point; and hence, in a meadow irrigated in winter, the water immediately in contact with the grass is rarely below 40°,—a degree of temperature not at all prejudicial to the living organs of plants.

"In general, those waters which breed the best fish are the best fitted for watering meadows; but most of the benefits of irrigation may be derived from any kind of water.

It is however a general principle, that waters containing ferruginous impregnations, though possessed of fertilizing effects when applied to calcareous soils, are injurious on soils that do not effervesce with acids; and that calcareous waters, which are known by the earthy deposit they afford when boiled, are of most use on siliceous soils containing no remarkable quantity of carbonate of lime."—*Agricultural Chemistry*, p. 305 *et seq.**

The proper business of irrigation begins in October, and is carried on till April, according to circumstances. In cold backward situations it is continued latest, and in warmer soils it is generally finished in February. As soon as the latter-math is eaten bare, the water-carriages are cleared out, and the stops and sluices made good. The water is then admitted on the land, and suffered to remain for two or three weeks, with a dry interval of a day or two; or, according to others, the water is continued on the meadow two weeks at first, then laid dry for one week, and again laid under water for two weeks more. The state of the grass affords the best rule to judge of the frequency of waterings. It is a general principle to make the meadows as dry as possible between every watering, and to stop the water the moment any scum appears on the surface, for that indicates the land has had water enough; in fact, it is caused by the fermentation excited by the decay of the grass. As soon as the land has been sufficiently dry after the last watering in February or March, the early grass, of which there is always an abundance, is consumed by ewes and lambs, if a breeding flock of sheep is kept. In order to prevent the sheep from trampling too much of the grass at first, some farmers use hurdles, by which they portion out the consumption of a day. Open spaces are left in the hurdles, to give the lambs free range of the meadow at large. Mr. Davis says, that one acre of good grass will be sufficient for five hundred couples for a day.

* To what Sir H. Davy has stated, may be added two other circumstances which operate as special excitements to the growth of flooded grass, namely, the rapid motion of the water, which increases its temperature: and to the fleece of water, which, while it acts as a covering against the contact of cold air, admits the full action of light upon the grass.—ED.

It is usual to leave off depasturing the meadows about the beginning of May; when the water is again admitted, to prepare the land for a crop of hay. Two days' flooding at this season is all that the land can receive without injury; it is then laid dry, and the process may be said to be finished for that season. Six weeks is usually sufficient to produce the crop of hay,—so rapid is vegetation in these meadows.

The following is a statement of the produce of a water-meadow of nine acres, belonging to his Grace the Duke of Bedford:—

1803. Stocked with twelve score sheep, and it kept them three weeks.

April 16. Shut up for hay.

June 23. Cut the crop for hay, supposed to be about two tons per acre.

August 20. Cut the second crop for hay, supposed to be about one ton and a half per acre.

September 16. Stocked it with four score of fat sheep: three weeks after that it was depastured with lean bullocks, as long and as often as they could find food.

1804. February 27. Stocked with eight score and four lamb hogs; they have now (April 28, the time this account was drawn up) been nine weeks in it. It had more and better water this last winter than that before; but from the want of grass upon the farm, it was in this instance eaten longer than it otherwise would have been.

Valuation.

1803. March 29. Two hundred and forty sheep	£.	s.	d.
three weeks, at 6 <i>d.</i> per head.....	18	5	0
Spring food per acre, at 2 <i>l.</i>			
June 23. Eighteen tons of hay, at 4 <i>l.</i>	72	0	0
August 20. Thirteen and a half ditto, at 4 <i>l.</i>	56	0	0
September 16. Eighty fat sheep, three weeks,			
at 4 <i>d.</i>	4	0	0
Lean bullocks.			

£.150 5 0

1804. February 27. One hundred and sixty-four
hog-sheep, nine weeks, at 5*d.* 30 15 0
Spring food per acre, 3*l.* 8*s.* 4*d.*

All the superior perennial grasses thrive under irrigation, when the meadow is properly formed. The following species of grass I have invariably found to constitute the produce of the best water-meadows. Meadow fox-tail (*alopecurus pratensis*), round-panicled cock's-foot (*dactylis glomerata*), field brome-grass (*bromus arvensis*), meadow fescue (*festuca pratensis*); these occupied the crowns and sides of the ridges. The furrows were stocked with the creeping-bent (*agrostis stolonifera*), marsh-bent (*agrostis palustris*), hard fescue (*festuca duriuscula*), lesser variety of meadow cat's-tail (*phleum pratense*, var. *minus*), woolly soft-grass (*holcus lanatus*), rough-stalked meadow-grass (*poa trivialis*), meadow-fescue (*festuca pratensis*), and a small admixture of other species, which were thinly scattered over every part of the ridge; these were, meadow-barley (*hordeum pratense*), yellow or golden oat (*avena flavescens*), crested dog's-tail (*cynosurus cristatus*), ray-grass (*lolium perenne*), sweet-scented vernal-grass (*anthoxanthum odoratum*), tufted vetch (*vicia cracca*): with a larger proportion of the tall oat-like soft-grass (*holcus avenaceus*). The meadow cat's-tail (*phleum pratense*), I never met with in irrigated meadows, but only the lesser variety of it, and that not very prevalent. It is a very common grass, however, in some natural meadows. The soil of the water-meadows which produced the above grasses was either a deep active peat, incumbent on a siliceous sand, or a sandy loam on a chalky or gravelly sub-soil. In some irrigated meadows that I examined, where the ridges were formed nearly flat, and the soil consisted of a sandy loam on a retentive clayey sub-soil, the following grasses constituted the chief produce: crested dog's-tail (*cynosurus cristatus*), creeping-rooted soft-grass (*holcus mollis*), ray-grass (*lolium perenne*), meadow-barley (*hordeum pratense*), tall oat-like soft-grass (*holcus avenaceus*), sweet-scented vernal, and soft brome-grass (*holcus mollis*). Though this soil was not entirely destitute of the superior kinds of grasses mentioned as the produce of the former meadows, yet they were in very small quantity, being thinly scattered over certain portions of the ridges only. It seems probable that the flatness of the ridges tended much to prevent these grasses from flourishing on the sandy loam

incumbent on clay, for I invariably found the head ridges, which had been raised considerably above the level of the rest, as the first conductors of the water, were plentifully stocked with the superior grasses, and as productive of grass as those of the first-mentioned meadows.

The hay of water-meadows is generally supposed to be less nutritious than the hay of rich permanent pasture land. I compared the quantity of nutritive matter afforded by these grasses, produced under irrigation, and those produced in rich permanent pasture land. The difference was much less than I had expected. An instance may suffice:—

Ray-grass from a water-meadow	72 grs.
Ditto, from a rich, dry, depastured ditto	95
Ditto, undepastured meadow	100
Ditto, from the rich undepastured soil	120

A water-meadow may be said to be a hot-bed for grass. The rapidity with which vegetation advances by the process of irrigation justifies the comparison. The small deficiency of nutritive matter in water-meadow hay, is what might be expected from such a cause; as we find it exemplified by daily experience, in the instances of esculent vegetables that are forced beyond their natural habits. The same effects are produced by the application of an excess of manure.

When a water-meadow is formed, if the original turf be fine, and free from the coarse inferior grasses, it will be found the most expeditious way to obtain a good sward, to replace the turf on the new-formed ridges, and afterwards to give a top-dressing with compost, and then to sow a mixture of the following grass seeds: *Alopecurus pratensis*, *dactylis glomerata*, *festuca pratensis*, *poa trivialis*, *holcus avenaceus*, and a small proportion of the *agrostis stolonifera latifolia*. The quantity of seed per acre, must be regulated by the state of the turf. Consolidating the surface with a heavy roller would be of infinite service, but the turf is often displaced by the operation. A light bush-harrow, therefore, drawn over the surface to cover the seeds, or rather to draw them into the interstices of the turfs, followed by a light

wooden roller, drawn by men, in the same manner as the bush-harrow, will be found the best mode of management.

It is customary, when forming a water-meadow out of inert peat-bogs, to throw the coarse surface (composed of sedges and rushes chiefly) promiscuously together, to form the ridges; but it would surely be more advantageous to pare and burn a surface of this nature, as it affords an abundance of excellent ashes; and without these, or a substitute perhaps of a more expensive nature, to apply as a top-dressing, previous to sowing the seeds, soils of this description remain for years in a state of comparative sterility. Caustic or hot lime is found to be the very best simple manure that can be applied to inert peat-moss, to bring it into a state of activity. When the ridges are formed of this soil, the surface should have a copious dressing of hot lime, which may be with advantage incorporated with the surface soil by a common harrow, and afterwards suffered to remain unmolested for a few weeks. A thick covering of the ashes, mixed with the cleanings of roads, waste headlands, &c. should then be applied; and the seeds of the before-mentioned grasses, with a larger proportion of the *agrostis stolonifera*, and an equal proportion of the *agrostis palustris*, sown at the rate of five bushels to the acre: the ground should be well rolled. I have made several trials to overcome the sterile nature of this soil, but in none was I successful, except in that where the above means were adopted. The best season for sowing the seeds of the grasses is in the beginning of May, or early in August. It may be unnecessary to remark, that if the soil becomes very dry, previous to the vegetation of the seed, which is seldom the case in lands of this nature, a gentle watering for one day will greatly promote the progress of vegetation: provided it can be effected without displacing any of the surface-dressing which covers the seed.

CHAPTER V.

OF THE DIFFERENT GRASSES, AND OTHER PLANTS, ADAPTED FOR THE ALTERNATE HUSBANDRY.

THE grasses, and other plants, best fitted for alternation, are such as arrive at perfection in the shortest space of time, or within the compass of two years; such as have their leaves broad and succulent, and that do not quickly run to seed. Plants of this description are supposed to produce the greatest weight of herbage at the least expense to the soil.

It is a curious and well-known fact, that any species of plant that has continued till its natural decay on a particular soil, cannot be again immediately reared with equal success on the same spot, till some other crop intervene; but that a *different* species of vegetable will there succeed better, for its peculiar period of life, than it would on a soil naturally better adapted to its growth, where it had just attained to perfect maturity. This holds good with respect to annual plants, as well as to those that continue to live many years. But it is better seen in the former, as their habits and duration in the soil are oftener and more directly within the reach of common observation.

On this antipathy of plants seems to depend the theory of alternate cropping with green crops and grain — varying in some measure according to the circumstances of soil and climate; but the principle appears to remain the same.

On analyzing a soil immediately before and after producing an impoverishing crop, the results of such analysis do not point out any diminution in the weight or proportions of its constituents, sufficient to account for the weight of vegetable matter produced. The decomposing animal and vegetable

matters of the soil are the only constituents wherein a sensible loss is perceived.

M. Braconnot grew plants in substances free from any kind of soil, as in flowers of sulphur, and in metal. He supplied the plants with distilled water only. They arrived, by these means, to a perfect state of maturity. The produce was submitted to careful analysis; and the results showed that the different vegetables so produced, contained all the constituents of the different species, precisely the same as when the plants were cultivated on their natural soils.

[Some have supposed that the antipathy of plants arises from the roots depositing a noxious matter in the soil. This is a new theory, and pretty generally adopted by scientific men, but by few practical farmers. Whether the land be exhausted or poisoned by a previous crop, the remedy is the same, whatever the real cause may be; namely, a change of crops, and fresh supplies of manure. — ED.]

The analysis of a plant, therefore, and of the soil which produced it, appear insufficient to account for the true cause of the impoverishing principle of vegetables to the soil, and why one species should exhaust it more than another.

Some useful information, however, on this very interesting point, may probably be drawn from facts obtained by daily practice and observation in the garden and the farm.

	Green Food. lbs.	Nutritive Matter. lbs.
Mangel-wurzel, or white beet (<i>beta cicla</i>), produces upon a suitable soil, or a deep rich loam, on an average, twenty-five tons of green food per acre, every pound weight of which contains 390 grains of nutritive matter; and therefore per acre.	56,000	3,120
Carrots (<i>daucus carota</i>), produce upon a deep light loam, on an average, eleven tons, every pound of which contains 750 grains of nutritive matter.....	24,640	2,640
Potatoes (<i>solanum tuberosum</i>), produce upon a fresh loam, of intermediate qua- lity as to moisture and dryness, on an		

	Green Food. lbs.	Nutritive Matter. lbs.
average, 15 tons per acre, affording of nutritive matter per pound 1,000 grs...	33,600	4,800
The common field or white turnip (<i>brassica rapa</i> , var.), affords from a sandy loam, upon an average, per acre, 16 tons of green food, a pound of which contains 320 grains of nutritive matter	35,840	1,638
The Swedish turnip, or ruta бага (<i>Brassica rapa</i> , var.), produces on a favourable soil, or a strong loam, on an average, 13 tons per acre, a pound weight of which affords of nutritive matter 440 grains	29,120	1,830
Cabbages (<i>brassica oleracea</i> , var.), which delight in a rich strong loam, afford of green food, on an average per acre, 25 tons, every pound of which contains 430 grains of nutritive matter.....	56,000	3,440
Kohl rabi (<i>brassica oleracea</i> , var.), the produce from a soil similar to that for cabbages or Swedish turnips, is on an average 14 tons per acre, and affords of nutritive matter per pound 420 grains	31,360	1,881

If a plant, therefore, impoverishes the soil in proportion to the weight of vegetable substance it produces on a given space of ground, the following will be the order in which the plants just mentioned exhaust the land.

Mangel-wurzel.....	25	} The proportions which they bear to each other with respect to weight of produce.
Cabbages	25	
White Turnip	16	
Potatoes	15	
Kohl-rabi	14	
Swedish Turnip	13	
Carrots	11	

Experience has long since proved, that carrots exhaust the soil in a much greater degree than white turnips; though, by this mode of judging, they impoverish land in a less degree than any of these plants. But when we take the weight of nutritive matter which a plant affords from a given space of ground, the results are very different, and will be found to agree with daily experience in the garden and on the farm.

Potatoes	63	} The proportion in which they stand to each other, with respect to the weight of nutritive matter per acre, and in exhausting the land.
Cabbages	42	
Mangel-wurzel.....	28	
Carrots	24	
Kohl-rabi	17	
Swedish Turnip	16	
Common Turnip	14	

The effects of some plants are only to impoverish the soil for an immediate succession of the same plant; while others have the property of exhausting the land, not only for an immediate succession of themselves, but likewise for every other kind of vegetable.

A consideration of the difference in the composition of component parts of the nutritive matter of different species of plants, it appears, will account in some measure for this property.

It has been already mentioned that the nutritive or soluble matter of vegetables consists, for the most part, of five distinct vegetable substances — mucilage or starch, saccharine matter, gluten or albumen, and bitter extractive, or saline matters. A plant, therefore, whose nutritive matter consists of one or two of these principles only, will impoverish the soil in a greater degree for an immediate succession of the same plant, than a different species of vegetable that has its nutritive matter composed of a greater variety of these substances. Hence, plants that have the greatest dissimilarity in the number and proportion of vegetable principles, which constitute their nutritive matter, will be found best fitted to succeed each other in alternate cropping. The different varieties of wheat consist almost entirely of

starch and gluten; while barley, peas, and turnips, contain a greater proportion of saccharine matter, which is wanting in wheat: and are consequently best qualified to precede or follow that grain, in alternation with green crops. Oats, rye, and beans, afford nutritive matters similar to wheat, though in less proportion; and a crop of either of these will have a like effect on the soil to that of wheat, though in a less degree, but totally different from those of barley, peas, and turnips. The former plants, therefore, as they impoverish the soil only for an intermediate succession of themselves, may be termed *partial impoverishers*; and the latter, exhausting the land for themselves, as well as, in a degree, for every other kind of vegetable, may be called *general impoverishers*.

If the nutritive matter of the following plants be examined with this view, they will be found to rank either as general or partial impoverishers.

General Impoverishers.

Oats.
Rye.
Potatoes.
Carrots.
Mangel-wurzel.
Cabbages.
Kohl-rabi.
Bunias Orientalis.

Partial Impoverishers.

Wheat.
Peas.
Beans.
Turnips.
Clovers.
Sainfoin.
Lucern.
Grasses, when mown.

It does not fall within the limits of these pages to give an account of all the plants employed in the *Alternate Husbandry*, but only of such as have been more particularly submitted to experiment in this series. There have been, however, several plants of this class made trial of, with respect to the quantity of nutritive matter they contain, some account of which will be found in the following pages.

TRIFOLIUM *macrorhizum*. Long-rooted Clover.

Specific character: Legumes racemed, naked, one seeded,



Trifolium

Macrorhizum.

bow striated, semi-ovate, stem erect. *Fig. 1.* Calyx and anthers.

Obs.— Sicilian Melilot Trefoil. — Leaves ternate, fleshy, subserrate; flowers yellow, small; legumes rather oblong, whitish, wrinkled, with semi-circular streaks; seeds bigger than in *t. melilotus officinalis*, racemes axillary, short, erect; legumes one or two seeded, subcompressed, pendulous, oblong, attenuated at both ends, acute, slightly curved in one side.

Native of Siberia, Italy, Sicily, and Barbary. Root biennial.

Experiments. — At the time of flowering, the produce from a rich clayey loam is 74,868 lbs. per acre.

The root of this species of clover is biennial when the plant is permitted to perfect its seed; but if kept from flowering, the root remains fertile for four or five years. It produces little after-grass, but a great weight of crop at the time of flowering. In this respect it is much superior to most other plants of the same class employed in alternate cropping, as the following particulars manifest:—

Trifolium pratense (broad-leaved red clover), produce per acre, herbage, 49,005 lbs.

Medicago sativa (lucerne), from a soil of the like nature, produces grass, 70,785 lbs.

Hedysarum onobrychis (sainfoin), produces per acre, herbage, 8,848 lbs.

It requires good shelter, and a deep soil. The deficiency of latter-math takes much from the merits of this plant. Under circumstances where it may be desirable to plough up the land after the summer crop is taken, hardly any plant can be more valuable than this one; as in this respect, from the foregoing facts, it is evident that the plant, on an equal soil, affords twice the quantity of nutritive matter of that afforded by the broad-leaved clover. The produce of lucerne, in quantity, comes nearer to this clover, but it is inferior in nutrient qualities. The long continuance of lucerne in the soil is therefore the chief advantage it possesses over this plant; however, when that, or depasturing, is par-

ticularly desired, the broad-leaved clover and lucern are greatly superior.

The value of the herbage of sainfoin is equal to that of the broad-leaved clover, and proportionally less than that of the long-rooted clover, as 10 to 11. The weight of crop being comparatively small on a soil of the nature above described, it is doubtless inferior. On dry hilly situations, and chalky soils, however, it may be their superior in every respect, on account of its valuable herbage.

The white or Siberian melilot, which appears to be only a variety of the long-rooted clover, was cultivated by Arthur Young, Esq., as he informs us in his "Annals of Agriculture." The produce, by drilling on a moist loam, with a cold marshy bottom, was seven and a half tons per acre. It was given to horses, working-oxen, and calves, and they ate it very readily, some even greedily.

From the foregoing details it is evident the long-rooted clover should be cut at the time of flowering. It can only be locally useful, as in instances where it is desirable to have the land ready to plough up before the beginning of August.

It flowers about the first week of July, and the seed is ripe in August.

TRIFOLIUM *melilotus officinalis*. Melilot Trefoil, Common Melilot, King's Clover, Hart's Clover.

Specific character: Legumes racemed, naked, two-seeded, wrinkled, acute; stem erect.

Obs.—This is very nearly allied to the long-rooted clover. The root, however, appears to be strictly annual. The lower leaves are oblong wedge-shaped; the upper ones elliptical, they are more serrate, and smaller in every respect than those of the long-rooted clover. The flowers are smaller, and more drooping. The legume contains often more than two seeds, which is seldom, or, according to my experience, never the case in the long-rooted clover.

Native of Britain. Root annual.

Experiments. — At the time of flowering, the produce from a clayey loam is 37,434 lbs. per acre.

Horses and sheep are said to eat this clover, as are also cows, goats, and swine. Dr. Withering says, that water distilled from the flowers possesses but little odour in itself, but improves the flavour of other substances. It does not appear to have been cultivated in England. Professor Martyn observes, that there cannot be a worse weed among bread-corn; for a few of the seeds ground with it, spoil the flour, by communicating the peculiarly strong taste of the plant: notwithstanding this, horses are said to be extremely fond of it. Some Italian writers call it *Trifolium caballium*.

From the above details, it is very much inferior to the long-rooted clover, and cannot be put to any use for which that species is not equally good or superior: it grows chiefly in clayey soils. In very exposed situations it attains only to a small size; while in such as are much sheltered, I have found it exceeding six feet in height.

It ripens an abundance of seed. Flowers in the third or last week of June.

VICIA *cracca*. Tufted Vetch.

Specific character: Peduncles many-flowered; flowers imbricate; leaflets lanceolate, pubescent; stipules half arrow-shaped, mostly entire.

Obs. — Root creeping, perennial. Stems quadrangular, weak, striated, attaining a great height when growing in hedges. Branches alternate from the axils of the upper leaves. Leaves alternate, consisting of from eight to twelve pair of leaflets, and terminated by a long branched and curling tendril. Leaflets oftener alternate than opposite, more or less hoary on both sides, with silky hairs, commonly rounded at the end, and terminated by a short point. Flowers of a purple or violet bluish colour. Legume half an inch long, containing four or five globular seeds, the size of a lentil.

Experiments. — At the time of flowering, the produce

from a clayey loam in an exposed situation is 10,890 lbs. per acre.

This species of vetch is chiefly confined to woods and hedges in its natural state: I have found it in two instances among the herbage of irrigated meadows. When growing among bushes, a space of ground equal to that above mentioned, afforded 48 oz. of herbage, or three times the weight of that cultivated in an open situation. Dr. Plot, in his History of Staffordshire, says, that this and the *vicia sylvatica* advance starved or weak cattle above any thing yet known; and Dr. Anderson, in his Essays, speaks highly of this plant. It is inferior to common tares (*vicia sylvatica*) in the quantity of nutritive matter it affords, but contains much less superfluous moisture. This must give it a superiority, in regard to nutrient properties, over tares, which contain an excess. But it has a strong creeping root, that will always prevent its admission to arable lands. It might be best cultivated on tenacious soils, and used after the manner of lucern, than which, though greatly deficient in the weight of the crop, it is nevertheless more nutritive.

Flowers about the middle of July and the beginning of August, and the seed is ripe at the beginning of September.

VICIA *sylvatica*. Wood Vetch.

Specific character: Fruit-stalks many-flowered; leaflets elliptic; stipula crescent-shaped, toothed.

Obs.—Stems running to a great height in the bushes where it grows, and spreading widely, so as to choke its supporters. Leaves of six or nine pair of leaflets, mostly alternate. Stipulæ in pairs, small, deeply divided into several awl-shaped segments. Flowers whitish, with beautiful pencil-streaks of blue. Pods lanceolate, smooth, pale brown.

Native of Britain, and most parts of Europe, from Sweden to the south of Italy; also of Siberia. Root perennial.

Experiments.—At the time of flowering, the produce from a clayey loam is 8,167 lbs. per acre.

The habits of this vetch are similar to those of the *vicia cracca*, but it seems more impatient of exposure: it thrives better where it has the support of bushes. When transplanted to open situations, the produce is inconsiderable compared with that of the *vicia cracca* or *vicia sepium*; though in its natural place of growth the produce is six times that of either of these vetches; it is likewise superior in the quantity of nutritive matter it affords. Horses, cows, sheep, and the South American sheep (llama), ate this vetch with more eagerness than they did the other vetches or natural grasses that were on several trials offered to them.

Of all the different vetches that were submitted to experiment, the winter tare, or common vetch (*vicia sativa*, var.), afforded the most nutritive matter; which confirms the justice of that preference which practice has given to the winter tare.

Flowers in July and August, and the seed is ripe in September.

PHALARIS *Canariensis*. Manured Canary-grass.

Specific character: Panicle spike-like, ovate; husks of the calyx boat-shaped, apex quite entire; corolla four-valved, outer smooth, inner villose.

Obs.—Culms from six inches to three feet high, according to the richness of the soil, erect, roundish, somewhat compressed; leaves linear-lanceolate, acute, flat, rough; florets ovate-compressed, outer convex, inner somewhat concave; nectary, two fleshy concave pear-shaped substances on the outside of the base of the corolla.

Native of the Canary Isles, now also of England, France, Spain, and New Zealand. Root annual.

Experiments.—At the time of flowering, the produce from a rich clayey loam on a tenacious subsoil is 54,450 lbs. per acre.

This grass has been cultivated in England for the sake of

opinion, that it is likely to be the best grass for the dairy. But the diminutive size of the plant renders its cultivation unprofitable, compared with that of any other of the pasture grasses; and besides, it is an annual, which, though it continues to produce flowering culms during most part of the year, nevertheless it is soon injured by frost, and often killed by a continuance of dry weather. But the most effectual remedy to destroy this grass when growing in pitchings, and on gravel and sand walks, is by an application of common salt, which, since the reduction of the duty on this article, can be had at a price that will allow of its application economically. The best manner of applying it is, just after the pitchings or walks have been cleaned, to strew the salt over the surface sufficiently thick to make each particle of the salt touch another. This dressing will be found to prevent the vegetation of the seeds or roots of the grass. It will also be found to destroy worms and slugs.

The *poa annua* flowers and ripens its seed throughout the summer.

AGROPYRUM repens. Creeping Wheat-grass, Couch, Quitch, Dog's-grass, Quicks.

Specific character: Calyxes five-flowered, awl-shaped, many-nerved; florets acuminate; leaves flat; root creeping.

Obs.—Root perennial, powerfully creeping, jointed, coated; fibres downy; stems slender, upright, two feet high, but acquire a much greater height when drawn up in hedges; round, smooth, striated, having five or six joints, which are frequently tinged with red; leaves spreading very much, smooth on the under surface, on the upper and the margin rugged; they are often directed on one side; spike nearly upright, two or three inches long, flat, composed of numerous spikelets, often more or less awned.

Experiments.—At the time of flowering, the produce from a clayey loam is 12,251 lbs. per acre.

This species constitutes the principal of what is termed

couch-grass, in gardens or rich cultivated grounds. The *holcus mollis*, and *poa pratensis*, are the proper couch-grasses of light or sandy soils. The *agrostis alba* is chiefly troublesome as couch in clayey lands. Forking out the roots after the plough, is doubtless the best mode of extirpating this noxious weed; but the process must not be discontinued while a particle of the root is suspected to remain in the soil, as the least portion will grow, and the land being so much broken and loosened by the operation, gives double encouragement for the rapid growth of the plant. It does not thrive well when combined with other grasses, but is naturally more common in hedges, or in orchards, where, if it be generally established, it yields a favourite and nutritious pasture for lambs.

The roots contain a large proportion of nutritive matter; they are esteemed abroad for feeding horses; at Naples, they are collected in large quantities for this purpose, and brought to market. My friend, the Rev. Thomas Roy, sent me some of these roots from Naples; they were much larger than I had seen of British growth. On trial, the given quantity afforded 6 dr. 2 qr. of nutritive matter, being, in this respect, superior to the English roots in the proportion of 26 to 23. Dogs eat the leaves of this grass, and also those of the *holcus avenaceus*, to excite vomiting. The nutritive matter from the leaves contains an excess of bitter extractive and saline matters.

Flowers about the beginning of August, and the seed is ripe about the end of the month, but is seldom good, being subject to mildew in its last stage of growth. Some farmers never pick off couch from the fallows, but trust entirely to the plough, which, if repeatedly applied, will destroy the couch effectually, unless in a very wet season.

MILLIUM *effusum*. Common Millet-grass.

Specific character: Flowers paniced, dispersed, awnless.

Obs.—Stems generally rising to three or four feet in height, with about four joints; leaves smooth, thin, and weak; panicles from four inches to a foot in length;

branches loose; pedicles often in whirls, diverging by glands fixed in the axils, which has caused it to be mistaken sometimes for the *poa retroflexa*, or *p. distans*. Mr. Curtis observes, that it is distinguished from the panics, to which it has the greatest natural affinity, by having a calyx of two valves only. Root perennial.

Experiments.—At the time of flowering, the produce from a light sandy soil is 7,827 lbs. per acre.

The common millet, in its natural state, seems to be confined to woods as its place of growth. It will thrive and grow, however, when transplanted to open exposed situations. It is remarkable for the lightness of the produce in proportion to its bulk. The foliage comes pretty early in the spring, but appears, from the above results, to be but little nutritive. Birds are remarkably fond of the seeds; so much so, as to raise a doubt whether, for the sake of the seed only, it could be cultivated to advantage on the farm. But in covers, where game is preserved, there cannot be a better grass encouraged; it will save the corn fields. About the beginning of August is the best season for sowing the seed. The surface of the ground, near the roots of the bushes, should be lightly stirred, and the seeds scattered over it, and raked in; a few of the decaying leaves that cover the ground should be afterwards thrown over it.

It flowers in the second week and latter end of June, and the seed is ripe in the middle of July and the beginning of August.

AGROSTIS *Mexicana*. Mexican Bent-grass.

Specific character: Panicle oblong, heaped; calyx and corolla acuminate, and nearly equal.

Obs.—Culms numerous, from one to two feet high, according to the nature of the soil it grows in, branched, erect; leaves smooth; sheath-scale truncated; panicle pale green, tinged with purple, according as it is produced in full exposure to the sun, crowded with scabrous florets; calyx valves unequal, shorter than the corolla; corolla valves nearly equal, hairy at the base.

Linnæus observes, that it is very difficult to distinguish this species.

Native of South America. Root perennial. Introduced into England by Mr. Gilbert Alexander, in 1780.

Experiments.—At the time of flowering, the produce from a rich black siliceous sandy soil incumbent on a tenacious sub-soil is 19,057 lbs. per acre.

It delights more in calcareous or clayey soils than in those that are of a siliceous sandy nature. It perfects an abundance of seed, which, when sown, produces plants that soon arrive at perfection. So far, therefore, it possesses the requisite properties of a grass adapted for the alternate husbandry; but it is late in the produce of foliage in the spring, and that herbage is not distinguished by any superior nutritive powers. It is perfectly hardy. Being a native of a warmer climate, its defects may possibly be greatly lessened by being naturalized, and by frequently raising it from seed successively ripened in this country. At present it does not offer any strong reasons to recommend it further to the notice of the agriculturist.

It flowers in the third week of August, and the seed is ripe towards the end of September.

From the facts brought forward in this and the preceding series, it appears manifest that there are but a small number of the natural grasses peculiarly fitted for the alternate husbandry.

The meadow-foxtail (*alopecurus pratensis*) is early, productive, and nutritive, but it does not arrive at perfection so soon as many other grasses. The seed is also often defective, and the crop in consequence cannot be depended on.

Meadow cat's-tail (*phleum pratense*) arrives speedily at perfection. It is very productive in the fore-part of the season, and the foliage and culms are very nutritive; but it runs much to stalks, and the after-grass is very trifling.

Rye or ray-grass (*lolium perenne*) comes soon to perfection, and when in a young state produces a plentiful supply

of early foliage. After the time of flowering, however, it produces comparatively nothing during the rest of the season; and unless the culms are mown previous to ripening the seed, the ground is much impoverished by it. The new varieties, however, of this species of grass, which have been discovered of late years, remove in a considerable degree the serious objections which applied to the common ray-grass. These new varieties have been already mentioned. For the alternate husbandry, ray-grass should be combined with other species of the natural grasses and with clovers.

Hard fescue (*festuca duriuscula*) early attains to maturity; the culms are succulent and nutritious; it grows quickly after being cropped, and springs pretty early; but it is very deficient in the weight of produce.

Meadow fescue (*festuca pratensis*) is very productive and nutrient, but does not spring sufficiently early, and seldom attains to perfect maturity in two years. In some soils this grass attains to a maturity of produce in as short a time as ray-grass.

Tall oat-like soft-grass (*holcus avenaceus*) attains to maturity from seed in a very short space of time. It is very early and productive in the spring, and during the whole season grows rapidly after cropping, and the culms are succulent. The produce, however, is very deficient in nutritive matter, which contains an excess of the bitter extractive and saline principles.

Yellow oat-grass (*avena flavescens*) arrives soon at perfection; the produce is tolerably nutritive, but deficient in quantity.

Rough-stalked meadow-grass (*poa trivialis*) early attains to maturity; the produce is highly nutrient, but likewise deficient in weight.

Smooth-stalked meadow-grass (*poa pratensis*) is early, and rather nutritive, but comparatively unproductive. The creeping roots unfit it for introduction on arable lands.

Crested dog's-tail (*cynosurus cristatus*) is backward in arriving at maturity. The produce is very nutritive, but wanting in weight.

Fertile meadow-grass (*poa fertilis*) soon attains to matu-

rity; the produce is highly nutritive, but comparatively deficient in quantity.

Nerved meadow-grass (*poa nervata*) is productive, very nutritive, and affords an abundance of early foliage; but it does not attain to its full productive powers in two years.

Narrow-leaved meadow-grass (*poa angustifolia*) is greatly superior to the smooth-stalked meadow-grass in early growth, produce, nutrient properties, and reproductive powers; but, unfortunately, it possesses a strong creeping root, which exhausts the soil, and renders it inadmissible on arable lands.

Wood meadow-grass (*poa nemoralis*) soon arrives at maturity, and springs early; the spring herbage is likewise very nutritive, and produced in considerable quantity. The after-grass in the autumn is, however, very inferior.

Flat-stalked meadow-grass (*poa compressa*) affords much nutritive matter, and continues to vegetate from spring till autumn; but its deficiency, with regard to weight of produce, puts it out of the question for the purpose of alternate cropping.

Darnel-like fescue (*festuca loliacea*). This grass possesses all the valuable properties of ray-grass, and few of its defects. It would, doubtless, be the best substitute for that species in alternate cropping; but, unfortunately, it does not perfect a sufficiency of seed.

Cock's-foot (*dactylis glomerata*), though not possessing every excellence in a degree superior to those species now mentioned for the alternate husbandry, nevertheless, it appears to have a greater variety of merits for this purpose than almost any other grass. It soon arrives at maturity; it bears cropping well, is very productive, and its nutritive powers are considerable. It is much less impoverishing to the soil than ray-grass, and when ploughed in affords a greater quantity of vegetable matter to the soil. It has been objected to cock's-foot, that it rises in tufts, and is apt to become coarse. But the objections will apply to every grass that is not sown sufficiently thick to occupy with plants every spot of the ground, and that is not afterwards sufficiently stocked to keep the surface in a succession of

young leaves. It is the practice of thin sowing, and the strong reproductive powers of the plant, that occasion it to appear a hassocky grass. If one species only is therefore thought preferable to several in the alternate husbandry, there is scarcely a species to be preferred to the *dactylis glomerata*. But with respect to an early and certain supply of the most nutritious herbage throughout the season, it will be found a vain labour to look for it in one species of grass, but only where Nature has provided it, in a combination of many. It will likewise be found, that the *dactylis glomerata*, from its more numerous merits, should constitute three parts of a mixture of grasses adapted for the purposes of the alternate husbandry. The different species most proper to combine with cock's-foot, are such as possess in a greater degree the properties of which this grass is deficient. For this purpose, none appear better fitted than the *festuca duriuscula*, *festuca pratensis*, *poa trivialis*, *holcus avenaceus*, *phleum pratense*, *lolium perenne*, and white clover, which should be in a smaller proportion. A combination thus formed of three parts cock's-foot, and one part of these species just mentioned, will secure the most productive and nutritive pasture in alternation with grain crops, on soils of the best quality; and even on soils of an inferior nature, under the circumstances of unfavourable seasons, will afford nutritive herbage, when otherwise the land would have been comparatively devoid of it, if one species of grass only had been employed.

APPENDIX I.

THE mode of returning tillage land to permanent pasture, called transplanting, was invented by Mr. Whitworth, of Acre House, Lincolnshire; and Mr. John Blomfield, of Warham, Norfolk, first practised it to any extent, having, in 1812, or the following year, converted thirty-two acres of tillage-land by this mode.

In 1817, Mr. Blaikie published a full account of the process, with details of the merits of the new practice; from which work, the information communicated by Mr. Whitworth, by correspondents who have tried this new mode, and from my own personal observations, the following statements and remarks are furnished.

In laying down land to permanent pasture by this mode, it is essential that the soil should be free of the seeds and roots of weeds, and made perfectly clean by a clear out summer fallow. The autumn is the best season for transplanting turf, and the sooner the work is begun at this season the better, provided the autumnal rains have sufficiently moistened the turf to fit it for paring off clear. By transplanting in autumn, the roots of the grasses get established before the commencement of warm weather in the spring, and stored with sap to supply a more luxuriant crop of grass than when the turf is delayed planting until February and March. On a farm of the Marquis of Tavistock, at Oakley, I witnessed the important effects of particular seasons in transplanting turf. One part of the field had been transplanted in the autumn, and another portion at different periods of the spring. The superiority of the

autumn-transplanted portion of the field was observable at a considerable distance, and when closely examined could hardly be distinguished from old pasture land. In the like proportion, the earlier spring-planted land held the same superiority over the latter spring-planted ground.

In this new mode of returning tillage-land to pasture, it is also essential that the turf should be selected or taken from the very best pasture, for otherwise weeds and inferior grasses will be propagated.

If the field, from which the turf is to be taken to make the new pasture, is intended to be broken up for a course of tillage crops, then the whole of the turf may be pared off, and employed in forming the new pasture to the required extent. But should the field be required to remain in permanent pasture, a portion only of the turf must be taken from the field, and a sufficiency of the sward, or grass plants, left standing for that purpose.

In the first of these cases, Mr. Blaikie directs a paring-plough to be used; but if that cannot be conveniently obtained, a common plough, with the coulter and share made very sharp, will answer the purpose; a wheel-plough is preferable to a swing-plough for paring turfs, because it goes steadier, and cuts the turf more regularly. The turf should be cut about two inches and a half thick, and seven, eight, or nine inches wide, according to the nature of the turf-gauge of the plough, and the width of the wing of the share; it is sometimes cross-cut into short lengths, previous to the operation of paring; but this can only be effected when the turf is moist, and free from stones. The cross-cutting is done by a scarifier with scimeter tines, the convex edges made very sharp, and faced to the work, and the implement heavily weighted, so as to press the tines a proper depth into the turf, into small pieces; but it gives more trouble, and increases the expense of filling into carts; for when cut into small pieces, in the first instance, it requires to be filled with shovels, whereas, if left in large flags, it is readily filled with forks or by the hand, when the turf is tough, and hangs together. The turf is taken in carts (if

broad wheels so much the better) to the arable land on which it is to be planted, and then dragged out of the cart in heaps, set in straight lines, and at regular distances, in the same manner as dung-heaps are set in fields, and after the rate of fifty single-horse cart-loads to the acre. It is then chopped into pieces of about three inches square, and spread with shovels regularly over the ground. A scarifier with square or round tines, about one inch and a half in diameter, and set about one inch and a half apart, or four tines in a yard, is drawn regularly over the field, and again crossed at right angles, which takes out the cart-wheel tracts, levels the ground, and marks out the distances for placing the pieces of turf; but the operation of scari-fying cannot be practised when the ground is wet. It is, however, much better when the scarifier can be used, as it not only marks out the distances accurately, but it makes an opening for the reception of the plants, at the angles where the tracts of the tines cross each other.

The turf being spread, women and children are then employed to place or plant the turf, one piece in each intersection formed by the tracts of the scarifier; and with the foot or a wooden rammer, having a broad end to correspond with the size of the piece of turf, the plants, or turf, is pressed into the soil. One acre of turf divided in pieces, and placed as before described, will plant nine acres of arable land, as will appear from the following calculation:—

Suppose one acre of turf cut into pieces of three inches square, it will produce 696,960 plants, or pieces of turf.

One acre of arable land, marked out in squares of nine inches to the side of the square, or eighty-one square inches, and one plant to each square, will require 77,440 plants: consequently, one acre of turf will plant nine acres of arable land; each plant will stand six inches apart, and occupy a space of nine square inches, the blanks in each square being seventy-two square inches, to be filled up by the future growth of the plants.

Mr. Blaikie farther observes, that although this is the most common, and judged to be the most proper size for the plants, and distance for them to be set apart, yet it may

not always be convenient to allow so large a proportion of turf for plants to the acre. In that case, either the plants may be reduced or the distances apart extended.

The process for the second case, or when the field from which the turf is to be taken for transplanting is intended to remain in permanent pasture, is as follows:—the gauge of the paring plough may be set at nine inches, as before directed, but the wing of the share should be turned up at six inches, and, being made very sharp, will cut the turf on that side, while the coulter (also made sharp) will cut the turf on the other side; and the flat of the share will turn the turf out six inches wide, leaving ribs of grass three inches wide uncut. The cut turf being removed, the plough, set at the same gauge, is then drawn across the field, at right angles to its former direction, and cross-cutting the uncut ribs of grass, will leave patches of grass three inches square in each angle, consequently the same number of plants to the acre as before stated in the calculation for transplanting. After the turf is removed the field should have a good top-dressing, not less than thirty or forty loads per acre, of compost manure, or good vegetable mould. If the natural turf is deficient in any particular species of valuable grasses, the seeds of those should be sown at the proper season after the top-dressing is spread; after this the surface should be repeatedly well rolled. The turf will soon unite, and in many instances will be found materially improved from its former state, particularly so where the turf had been previously *hide-bound*, or mossed.

The turf may also be taken out of the grass-field in narrow ribs, suppose three inches wide only, leaving three inches uncut; then with a top-dressing of compost, and the ground thoroughly well rolled, the turf soon unites, and the herbage will be greatly improved. In the operative part of transplanting turf, particular attention is required in carefully turning the flag with its grass-side up, and in pressing the plants well into the ground; for if the roots of the plants are left exposed to the vicissitudes of winter weather, they will certainly be injured in a material degree. The whole process should therefore be effected with all possible expe-

dition, particularly when carried on in winter ; but which is not advisable, as frosts, more or less, are expected every night in that season ; no more turf should be cut, carried, and spread in the day, than is likely to be planted before night.

No stock of any kind should be admitted upon the young pasture until after the grasses have perfected and shed their seed.

The expense of converting arable land into pasture by transplanting turf (according to the certificate delivered by Mr. Henry Blyth, of Burnham, as a claimant for the premium offered by T. W. Coke, Esq., 1816, for the encouragement of this new description of husbandry), is as follows :—

	A.	R.	P.
Extent of grass-land pared to produce plants for transplanting ; the turf being clean pared off...	1	2	18
Extent of arable land transplanted with the above	11	0	15

<i>Expense.</i>	£.	s.	d.
To ploughing or paring 1 acre, 2 roods, 18 poles, at 10s. per acre.....	0	16	1½
To carriage of 600 loads of turf, 50 days' work for one horse, at 3s. per day.....	7	10	0
To lads driving carts, one boy fourteen days, at 1s. 2d. per day, and one ditto at 10d. per day	0	19	8
To scarifying 11 acres and 15 poles of ground, when covered with turf cut in pieces, at 2s. 6d. per acre.....	1	7	8¾
To labourers, filling, cutting, spreading, and planting the turf on 11 acres and 15 poles of land, at 30s. per acre	16	12	9¾
	<hr/>		
	£27	6	4
	<hr/>		
Total expense per acre.....	£ 2	9	2¾
	<hr/>		

Mr. Blaikie observes, that in the foregoing estimate there is no allowance made for the expenses incurred by the clear

out-summer fallow of the arable land, nor of the year's rent, poors' rates, and taxes for that year; neither is there any charge made for restoring the land to its previous state from whence the turf-plants were taken: consequently there may be a very considerable additional charge made against the transplanted pasture.

Mr. Whitworth states the expense of the operative part of this process, per acre, to be 2*l.* 4*s.*, and gives the following details from his own minutes on the business. About 180 sods, of nine square inches, will be equal to one bushel measure, and 240 bushels will be equal to eight cart loads, which, at the rate of about nine sods to a square yard, will plant one acre of land. A man will cut with ease one bushel of sods in eight minutes; and two children in twelve minutes will gather them, put them into the cart, and assist him to plant that quantity; the whole time being twenty minutes. The planting will be at the rate of three bushels per hour, consequently, the day of ten hours will plant thirty bushels, and eight days will finish one acre.

	£.	s.	d.
One man eight days, at 2 <i>s.</i> per day.....	0	16	0
Two children eight days, at 6 <i>d.</i> per day	0	8	0
Carting turf, if near at hand.....	0	10	0
<hr/>			
Total per acre.....	£1	14	0
<hr/>			

But should the turf for transplanting have to be carted from a distance, the expense would be proportionally increased.

Having had an opportunity of examining some pasture land on the Duke of Bedford's estates, near Endsleigh, Devonshire, which, by the Duke's desire, had been formed by transplanting, I requested Mr. John Forrester, who conducted the work, to give me an account of the results; this he favoured me with, in a valuable communication. Mr. Forrester laid down to permanent pasture a field of sixteen acres; one half of the field was transplanted according to the mode above described, and the other half was sown

with the seeds of natural grasses and clovers. With the grass-seeds was also sown buck-wheat, which proved a heavy crop, and injured the seedling grasses, by enfeebling their growth. The turf for transplanting being close at hand, saved a great expense in carting, and the expense of the transplanted portion of the field exceeded but little that which was converted by sowing the seeds.

In both cases the pasture proved good, and equal to the best ancient pasture; but Mr. Forrester observes, that from the first year until now (five years from the time the pasture was made), that portion of the field which had been laid down with seeds has always produced more grass than the transplanted portion. In two other instances, one of a field of five acres, and another of two acres, treated in like manner as the above by Mr. Forrester, he obtained similar results.

On a farm of the Marquis of Tavistock at Oakley, before alluded to, I observed an improvement on the practice of transplanting turf; particularly as regards the recovery of a pasture partially deprived of its turf for the purposes of transplanting. It has been recommended to take the turf out in strips, or ribs, six inches wide, and to leave ribs of grass uncut, of three inches in width, to continue the pasture; but here the turf was allowed to remain in ribs of from ten to twelve inches wide, which, with the liberal use of the grass-roller, had the effect of sooner covering the vacant spaces with grass, or of promoting the union of the edges of the stripes of turf, than when they were left of narrower dimensions. A piece of land in Woburn Park was planted with turf, but the expense of the process was here greater than what is mentioned above in the statements of expense. The turf was taken out in stripes six inches broad, and ribs of grass left three inches wide, to continue the pasture, precisely according to the directions above given. The edges of the stripes of turf left standing to continue the pasture did not however approach or unite, so as to furnish the naked spaces with plants, because there were not any creeping-rooted grasses in the sward to throw out lateral roots and plants; and the naked stripes, or furrows,

caused by the removal of the turf, being very inconvenient to the feet in riding or walking over the ground, they had to be filled up with mould, and afterward sown with grass-seeds.

The valuable permanent pasture grasses cannot therefore be said to be propagated or increased on the farm by this process of transplanting turf, but that they are merely removed from one field to another.

To bring forward to the reader facts capable of easy demonstration, and which cannot therefore mislead, has been a principal object of the writer of these pages.

Had the seeds of those different species of grasses which composed the turf used in these instances of transplanting, been sown on a separate part of the same field (or on a soil of the like nature as that on which the turf was transplanted), and had a dressing of rich mould, equal to that conveyed and applied to the transplanted portion by the turf, been given to the land sown down with these seeds; then the comparative value of the two modes of converting tillage land into permanent pasture would have been tried under equal circumstances. But it is evident, that if we plant ten, fifteen, or twenty different species of the proper grasses and clover in one field, and on another field or soil of the same nature sow the seeds of only one or two species of grasses and clover, it will surely appear unreasonable, if not absurd, to expect that the comparative value of these two modes of culture can be determined by the results of trials made under such unequal circumstances. Had the seeds of all these proper permanent pasture grasses, and of which the richest and most fattening pastures were shown to be constituted, been at the command of those eminent agriculturists who have put in practice this mode of converting tillage-land into pasture, the comparative value between planting the turf, and sowing the seeds of grasses, would have been satisfactorily determined, and the superior advantages accruing to the farm from the propagation and extended increase of the valuable permanent pasture grasses by seed, would then have been demonstrated. But, in the absence of these essential seeds from the market, at a price sufficiently low

to ensure as regular a demand for them as for ray-grass and clover, the practice of transplanting turf will be found highly useful; particularly in clayey and sandy soils, where a natural defect exists as regards the raising of seedling grasses, and which defect is corrected, and such soils improved for the growth of the valuable species of grass, by the rich mould supplied to the soil by the transplanted turf.

APPENDIX II.

OF THE GRASSES WHICH AFFORD THE BEST CULMS, OR STRAW, FOR THE MANUFACTURE OF STRAW BONNETS, SUCH AS WILL EQUAL, AND MAY SURPASS, THE FINEST LEGHORN MANUFACTURE.

STRAW-PLAIT, in imitation of the celebrated Leghorn manufacture, has been made in England for many years past, but the practice till lately had been confined to the London manufacturers of straw bonnets. Above seventeen years since, land was taken at Ampthill, on the estate of the late Earl of Upper Ossory, for the express purpose of raising straw for this kind of plait; and a few years since, a very fine straw bonnet was sent to the Duchess of Bedford from Leighton Buzzard, where it had been manufactured from English straw. About three years since, Miss Woodhouse, a farmer's daughter of Connecticut, transmitted to the Society of Arts in London, a straw bonnet in imitation of the Leghorn, made of the straw of *poa pratensis*, smooth-stalked meadow-grass (or the spear-grass of America), which, from its excellence, obtained the reward of the Society. Mr. Cobbett published an account of this circumstance in his "Cottage Economy," and also an account of his own experience in selecting the best grasses for the purpose, and of bleaching the green culms or straw, and for which Mr. Cobbett received the Society's medal.

The lady of the Rev. Mr. Morrice, of Great Brickhill, Bucks, manufactured a very beautiful straw bonnet, in imitation of Leghorn, of the culms of the crested dog's-tail grass (*cynosurus cristatus*), which, being submitted to the Society of Arts, obtained the Society's medal. Very great merit was displayed in the manufacture of this bonnet.

Mrs. Grant, of Leighton Buzzard, has made very successful trials with the bleaching and selecting of the straws of the perennial grasses for the Leghorn plait, and, from Mr. Grant's extensive knowledge of the British grasses, much assistance may be expected from his patriotic exertions.

The Duke and Duchess of Bedford, being desirous of introducing the manufacture of this kind of straw-plait among the children of the labouring classes at Woburn, and in furtherance of the intention of His Grace to establish here a girls' school for the purpose, combining therewith, at the same time, the means of moral and religious instruction to the children, I was instructed to proceed in the cultivation of such grasses as were most likely to supply the best culms or straw for the purpose. The wheat recommended by Mr. Cobbett, and which was said to be the same as that cultivated in Italy for the celebrated Leghorn plait, and which was also said to have been imported from thence, was sown on a siliceous soil, rather poor and exhausted, on the 27th of May. Five different varieties of oats were sown at the same time, and also a considerable number of the different species of perennial grasses, on a separate space of ground.

The wheat was sown on two distinct spaces of ground, at the rate of ten and of fifteen bushels to the acre respectively; and each of these spaces was again divided as to the mode of culture, one half of each respectively being sown in drills, and the other half broad-cast. The oats were treated in like manner. When the wheat came into blossom, it proved to be the common bearded spring or Cape wheat, which in this climate is very subject to the rust disease, or rubigo; and its power to supply clean or bright straw is therefore rendered very uncertain, even should a mode of culture be found out, under the circumstances of a British climate, that would afford culms or straw of this grain sufficiently fine, and at the same time of a texture sufficiently tough and firm for the Leghorn plait; but experience will prove, that these last-mentioned properties are not to be obtained here by this plant.

W. P. Taunton, Esq., of Bristol, communicated a specimen of wheat cultivated in Italy for the Leghorn plait; this proved to be a specimen of the *triticum spelta*, or spelt-wheat. Mr. Taunton states, that in Italy the wheat cultivated for the straw is cut over twice or thrice, or is eaten down by cattle, so as to render the culms which afterwards spring up very slender. The long Italian summer allows of that mode of culture, which this climate will not permit. The straw of Mr. Cobbett's wheat proved too coarse for Leghorn plaits, but would have answered for the *split-straw* manufacture. The straw of the fine varieties of oats was also too coarse, though clean and of a good colour. The expense attending the culture of grain for the straw merely, and the difficulty of raising it of the required degree of fineness for the Leghorn plait, without increased labour and expense in picking, seem to forbid the adoption of that mode of obtaining straw in this country for that particular purpose, more particularly when the perennial grasses offer culms or straw of a finer quality than is seen in any Italian plait, and which may be obtained at comparatively a very small expense. There are many species of perennial grasses adapted to supply fine and beautiful straw, the principal of which have already been noticed; but as several of these species of grasses affect soils of a different nature, it may be useful to mention the different soils peculiarly adapted for the growth of certain species, that those who may be locally circumstanced as to a particular soil, and who may be disposed to encourage the introduction of so valuable a manufacture among the females of the labouring classes, may be saved the temporary disappointment caused by cultivating a grass not adapted to the soil, or not calculated to afford the finest straw for the intention.

Heath, or black siliceous Moor-soil.

Festuca ovina, sheep's-fescue grass. Straw very fine and clear.

Festuca duriuscula, hard-fescue grass. Straw long, equal, and clear; but coarser than the sheep's-fescue.

Festuca ovina hordeiformis, long-awned sheep's-fescue. Straw long, clear, and equal.

Nardus stricta, upright matt-grass. Straw long without joints, very fine, equal and tough: perhaps the best grass for the supply of straw for the Leghorn plait.

Dry Soils.

Cynosurus cristatus, crested dog's-tail grass. Straw fine, strong, and tough, well adapted for plait: but the culms are frequently liable to discoloration, particularly after flowering.

Poa angustifolia, narrow-leaved meadow-grass. Straw very long, fine, and clear: superior to the *poa pratensis*, of which Miss Woodhouse's celebrated bonnet was made.

Hordeum pratense. Straw of the best quality for plait, being fine, tough, and clear.

Anthoxanthum odoratum, sweet-scented vernal grass. Straw clear and straight, but frequently rather coarse.

Agrostis lobata, lobed bent-grass. Straw short, but very fine, clear, and tough.

Agrostis spica ventis, silky bent-grass. An annual, straw long, fine, and clear.

Avena flavescens. Straw generally fine, bleaches well, and of an equal and tough quality.

Agrostis vulgaris mutica. Straw fine, bleaches easily, but is rather short.

Avena pubescens. Straw generally fine, long, and of a good colour.

Festuca heterophylla, various-leaved fescue. Straw similar to that of *festuca duriuscula*.

Damp or Moist Soils.

Agrostis canina fascicularis, bundled-leaved brown bent. Straw very fine and white.

Agrostis canina mutica, brown bent. Straw longer than the preceding, in all other respects similar to it.

Agrostis stolonifera angustifolia, narrow-leaved runner-

bearing bent. Straw long, tough, bleaches equally of a fine white.

Agrostis alba, white bent. Straw tough, and bleaches well.

Agrostis stricta, upright bent. Straw very fine, straight, and tough.

Agrostis repens, creeping-rooted bent. Straw long and equal, bleaches well, though not so fine as some others.

Poa nemoralis angustifolia, narrow-leaved wood meadow-grass. Straw very equal, fine, and tough, but not so long between the joints as some others.

Agrostis stolonifera aristata, awned runner-bearing bent. Straw long, equal, and bleaches very white, but works rather soft and flat in the plait. There are many other species of the perennial grasses, which afford fine straw, which might be added to the above list; but those named above have been submitted to careful trials, and are found to possess the properties stated. Any number of these species which come into flower at the same period, and which affect similar soils, might with advantage be sown together for the reasons already mentioned. There is scarcely a fibrous-rooted species of grass, that can be cultivated singly without much time and attention, in weeding or keeping out other grasses from combining with it in the soil: whereas, by sowing a mixture of those species which possess in common the properties above mentioned, they will keep possession of the soil, and render weeding almost unnecessary: and after the crop straw is taken, the grass or sward will be found more nutritious and productive for depasturing with sheep, than if it consisted of one species of grass only.

The results of all the experiments made here, prove, that the period of flowering is the best stage of growth at which to cut the straw for plait, in imitation of that of Leghorn. This material always exhibits a bland surface, unlike the glossy shining surface of an English bonnet made of the ripe straw of oats. On comparing the appearance of culms cut when in flower, with others cut at the time the seed is ripe, and after they have each been bleached, the former have a bland surface resembling the Leghorn, and the

latter a glossy surface like that of ripened grain. The culms at the time of flowering are also less hollow, and are more tough and pliable than ripened straw, and therefore easier to work into plait. From these facts it seems probable, that the Italian straw is taken when the plants are in flower.

The green straw may be bleached by the process detailed by the late Mr. Cobbett. The culms being selected and placed in a convenient vessel, boiling water is poured over them in quantity sufficient to cover the straw; in this they are to remain ten minutes: when thus scalded, they are to be spread out on a grass-plat to bleach; by turning them once a day, the bleaching is generally effected in seven or eight days. The bleaching, however, may be effected in much less time; especially if, instead of ten minutes, the straw be allowed to remain in the scalding water from one to two hours, and then spread on grass, regularly watered as they become dry, turning them once a-day for two days, after which the straw is washed clean from dust. It is then, in a moist state, placed in a close vessel, and subjected to the fumes of burning sulphur for two hours. This has been found sufficient to bleach the straw in the most perfect manner. Green straw immersed for ten minutes in a strong solution of acetic acid, and then subjected to the sulphureous acid gas, are bleached perfectly white in half an hour. Green culms, immersed for fifteen minutes in muriatic acid, diluted with twenty times its measure of water, and then spread on the grass, became in four days as perfectly bleached as those which were scalded and bleached for eight days on the grass. The texture of the straw was not in the least injured by these processes. The application of the sulphureous acid gas to the moistened straw, even after scalding and bleaching on the grass, had in every instance the effect of greatly improving the colour. It is necessary that the straw be moist during the application of the fumes of sulphur, to obtain the greatest use of the gas; for water absorbs this gas with rapidity, and assists the action of the gas, in destroying the colouring matter of the straw without injury to its texture. The only apparatus necessary for the

fumigation, is a platform of laths raised a little off the ground: on it the straw is laid; an iron pan holds the burning sulphur below, and a large tub is whelmed over all, to confine the fumes near the straw till the blanching is complete.

When straw is immersed in diluted acid, it should be whole, for if cut, the acid will get into the interior, which can answer no good purpose in discharging the colour.

To imitate the Leghorn plait in the most perfect manner, the straw should be plaited the reverse way of the common English split-straw-plait. In this last, the straws are flattened by a machine made for the purpose, but the Leghorn plait has the straw wrought without flattening, and pressure is applied after the plait is made. These two points should be observed by those who wish to rival the Italian plaiters. By reversing the common mode of plaiting, the fingers have a much greater power in knitting firmly and intimately the straws, and the unflattened state of them allows of their being more closely knitted; a circumstance which gives the appearance of fineness to the real Leghorn plait, which, had the straw been flattened by milling, would have given it a coarse and unfinished appearance. It is feasible to apprehend that Leghorn plait may be successfully imitated in this country, and from perennial grasses of our own growth, provided we adopt the Italian method of preparing and manufacturing the article.

The foregoing pages contain the substance of the talented author's discoveries, and results of his practical experiments during his laborious investigation of the natural order of the grasses and other plants useful in agriculture. Every experiment which he conducted was executed with the greatest accuracy. Whether made in the field or garden, or in his laboratory, the most trifling minutiae were attended to, in order that he might not be deceived in the consequences. His descriptions are equally precise: he was in the pursuit

of practical facts ; and he considered himself bound to detail every circumstance of soil, situation, and season, which he has done with the utmost faithfulness.

As practical men in general have very rarely either time or opportunity to make such trials as have been made by the late Mr. Sinclair, the results which he has recorded, will long continue to be regarded as a most useful portion of agricultural knowledge. His facts and conclusions will always be a guide to the farmer, as well in the choice of his seeds, as in the preparation of his land for their reception. Because, it was not only the facilities allowed him in the prosecution of his chemical trials, and the high scientific advice he received during the execution ; nor was it from the necessarily contracted trials made in the grass garden, on which he has founded his conclusions ; but from the actual practical proceedings on a great scale on the Park Farm, conducted by the late Mr. Wilson, one of the first agriculturists of the kingdom.

Thus, while our author was experimenting in the garden and laboratory, similar processes were going on in the fields ; and the aggregate results determined the inferences to be drawn from the whole, as set forth in the previous sections of the work. It is indeed the accounts of these field operations which constitute the chief value of this volume, and which, for the management of grass and pasture land, will always be considered a first authority on this branch of agriculture.

The experiments of the author are particularly useful in another point of view : — Long before these trials were made, *experience* (that grand and infallible teacher, especially in the rude and simple business of husbandry) had identified certain plants, some of which were British, others foreign, as being particularly relished by domesticated cattle. These plants were slowly introduced into cultivation, such as lucern, sainfoin, tares, clover, ray-grass, &c. These were among the first wild plants which were reclaimed from the wastes ; and certain natural pastures were famous for fattening properties ; which, as soon as noticed, was

attributed to the pasture containing a large share of the superior grasses; which grasses are those that have been tested and botanically described by our author. But what we have to remark concerning these tests, is this,—that they completely justify the preference previously given by cattle and their intelligent owners; all being found, by chemical analysis, to be superior in nutritive qualities to those plants which were neglected.

We know well, that it has been objected to chemical tests, that they do not always accord with the tastes of animals. It is difficult to say what are really the most nutritious qualities of plants: sugar and albumen may be considered as such. But we know that neither of these, however pure, singly or together, would ensure the ready fattening of an animal. The food requires an admixture of fibrous matter with that which is mucilaginous. And besides, we know that fodder, whether green or dry, and which, if tested chemically, would be declared worthless, would, if previously sprinkled with either salt or sugar, particularly the former, be eagerly devoured by cattle of any kind. And we always observe that the instinct of brute animals invariably leads them to choose that which is most suitable to them, their olfactory and palative faculties acting in their service instead of judgment. And yet we often hear of cattle picking up noxious herbage: and we know that they will eat what will kill. The preferences shown by cattle are therefore supposed to be better proofs than those obtained from the analysis of the chemist.

The chemical analysis of oil-cake shows how rich it is in oleaceous, fattening qualities; and we know the rapid improvement in the weight of beasts fed with it: but neither the scent nor taste of this substance is inviting to cattle when it is first presented to them, it often lying two or three days in the manger or troughs before they will touch the cake, though at last they become exceedingly fond of such unnatural food. This would tend to show that cattle are not judges of what is best for themselves, and that in the process of artificial or stall-feeding, the chemist could pre-

scribe for them with more certainty than they can choose for themselves. But here we must distinguish between what is merely necessary and what is redundant.

When ranging at large, however, in their pastures, we always see them linger upon the driest parts of the fields; for there the grass, if there be any bite at all, is always not only the sweetest, but also the most nutritious. There are pastures in this kingdom, which in spring and autumn, or in showery summers, yield herbage enough, but of the most inferior quality for fattening stock; whereas, at about Midsummer in every year, and in particularly dry seasons, the grass, though short, is of the most nutritious description; every thing thrives upon it: and if the same be made into hay, it is always richer, and more palatable to cattle than that made from the lower and moister parts of the pasture.

It is curious to observe the display of taste shown by a stray horse or cow, which by accident gets into a rick-yard where there are various kinds of hay, and other fodder in ricks. A general examination is first made, and should there be a small rick or part of a rick of vetch-hay got up without rain, that is preferred to every thing else. If nothing of this kind invites, then sainfoin is the next selected; and if one layer of the rick be better than the rest, that layer will be eaten as far as they can reach. Upland meadow-hay, if quickly and well got up, and retaining its fine green colour, is the next choice; and afterwards, any other sort of meadow-hay well made, and which has taken the necessary heat in the rick. The above are what kine and sheep prefer; horses are first attracted by the hay of vetches and sainfoin, and next, the first crop of clover, especially if there be a good portion of ray-grass along with it. Indeed, we have often seen, when ray-grass alone has been mown and made early enough, it has been relished by horses before any other kind of hay; and certainly the substantiality, and great portion of sugar contained in the straw of this grass, renders it one of the richest kinds of fodder, especially for horses. It requires, however, much care in making and ricking, as it takes a violent heat, and is liable to burn if suddenly put together in a large rick.

The qualities of every kind of hay (independent entirely of the intrinsic value of the grass), depends greatly on the manner in which it is made. The richest grass may be spoiled by wet weather, or carelessness. And very inferior grass, by judicious management in the field and in the rick, may become not only palatable, but most nutritious food for cattle. Hence, we cannot always depend entirely on the results of chemical analysis, and therefore the safest plan in the choice of our grasses, is to combine the proofs of the chemist with the discoveries of experience.

Taking this as a rule, the *Hortus Gramineus Woburnensis* will always be found a most useful directory, and will always deserve a place on the book-shelves of the farm-house.

There were two principal objects in view in undertaking this analysis of forage plants. The first was, to detect the most valuable; and the second, to identify the most worthless, or such as are considered mere weeds by farmers. That those two classes of plants should be well known is universally admitted. And a knowledge of the weeds of agriculture was considered so necessary a part of agricultural botany, that the late B. Holdich, Esq., Editor of the Farmer's Journal, had, before his decease, nearly completed a little work on this subject; and which was bequeathed to Mr. Sinclair to finish, prepare for the press, and publish for the benefit of Mrs. Holdich. This tract being intimately connected with the design of the *Hortus Gramineus*, and belonging to the same proprietors, they have resolved to annex the former with the latter, in order to enhance the value, and improve both, by uniting them in one moderate-sized volume.

THE

Weeds of Agriculture.

THE term weed is not definite. By some writers the term is used to denote all uncultivated plants. By others, those plants which are, from their specific qualities, hurtful to man or beast; but the best definition seems to be that given by an old botanist, namely, that "a weed is a plant out of its proper place." Oats are not weeds; but, if they grow among barley, they are, in the estimation of the maltster, the worst weed that grows. So the common winter tare is not a weed; but, if sown and harvested with wheat, it greatly deteriorates the sample at market.

In Mr. Holdich's pamphlet, before alluded to, weeds are described in four classes. First, Weeds which infest samples of corn. Secondly, Fallow-weeds, or such as are hard to destroy. Thirdly, Rampant weeds, which encumber the soil. Fourthly, Weeds which never rise into the sickle; with observations on those in pastures.

In making extracts from this little work, for our present purpose, we shall retain only the most useful parts, adding such observations as will serve to elucidate the subject, and render the whole as intelligible as possible to practical men. The Essay is inscribed to the *young farmers* of Great Britain by Mr. Sinclair, who also added the following advertisement, *viz.*

The following Essay, in an imperfect state, the first chapter only being perfected in manuscript by the Author, was bequeathed to the care of the Editor, who has endea-

voured, as much as in his power, to supply what was wanting to complete the original design. The Author's introductory remarks explain the origin of the Essay; viz. the inquiries of a "Young Farmer" for a treatise on weeds.

Mr. Holdich was a practical farmer of very great ability, as well as a man possessing the most extensive and correct knowledge on rural affairs; which knowledge he acquired solely by his own industry and application, united to superior natural talents, and which procured him the approbation of the public, as well as that of the personal friendship of the first agriculturists of the day.

It may be said, that after the manner in which the subject has been treated by Mr. Pitt, in his Essay; by Professor Martyn, in his edition of Miller's Dictionary; and particularly by Sir John Sinclair, in his great national work, the Code of Agriculture (which should be in the hands of every farmer),—this publication was uncalled for; yet, nevertheless, it has been called for, and it is surely unnecessary here to mention the great advantages of a manual on a subject of so much importance to good husbandry, and which cannot be too often or too early impressed on the minds of young farmers, for whose especial use the Author designed his essay.

Introduction.

It has happened, that an essay on weeds and their destruction, has never been published. During the continuance of the Board of Agriculture, an essay of this kind was sent to the Board, by Mr. Pitt, of Wolverhampton, containing a pretty long catalogue, but with many important omissions, and without any practical arrangement. Mr. Pitt understood botany very well, but knew little of agriculture. His essay is to be found in the fifth volume of the Communications to the Board of Agriculture, printed in 1806.

It seems somewhat strange, at this advanced period of agricultural knowledge, that so many queries should be put,

“How to destroy black grass?”—“How to destroy colt’s-foot?” &c.; as if there were any secret known to a few, or any charm in existence, by which an overwhelming increase of any particular weed could be stopped at once. But the world is always in a state of pupilage; some are learning what others know; and the queries which to the young are interesting, are to the experienced and wise trifling and superfluous. So it must be with essays on agricultural subjects, which can only be directed to the general instruction of the inexperienced; while the practised and sagacious agriculturist must be requested to pardon the particularity with which things well known to him are so tediously written down.

CHAPTER I.

OF WEEDS WHICH INFEST SAMPLES OF CORN.

THE weeds of this description do not exceed ten in number, and it very rarely happens that more than two sorts are found associated in one sample of wheat. They vary as to soil so much, that some of the worst weeds in fens and marshes are not known at all on clay cold soils, and are but very little seen on any sort of dry turnip land. Light loams and deep loose soils generally have most weeds by nature. It seems therefore desirable to divide weeds also as to the soils on which they prevail; but this may be supplied by proper remarks added to each.

Weeds which infest the sample are, 1. Darnel. 2. Drank. 3. Cockle. 4. Tares. 5. Melilot. 6. Wild Oats. 7. Hariff. 8. Crow-needles. 9. Black-bindweed. 10. Snake-weed. 11. Charlock-seeds, in barley sometimes.

1. DARNEL (*lolium temulentum*). True Darnel.

Specific character: Culms two feet or more in length, rigid, jointed; spike bearded, flat, a foot long; seeds ripen with wheat.—*Fig.* 1. Spikelet. 2. Lower calyx with its occasional elliptical appendage. 3. Flower. 4. Germen, style, and nectary. This plant is a native of Britain, and is marked in books as an annual: but it is more properly in this country a biennial; because it does not ripen its seed freely, unless sown in the autumn. The seeds are large, and nearly the size of the smaller grains of wheat; they are also equally heavy.



Lolium Temulentum et arvense.



Lolium Temulentum.

On this account, the darnel cannot be separated from the wheat by any of the machines we have in use for cleaning corn. Neither birds nor beasts choose this detested plant as food. It is excessively bitter, and if ground with wheat into flour and made into bread, it renders it not only unpalatable and unwholesome, but actually poisonous.

It has been said, that, when harvested with barley and malted therewith, the beer made from such admixture is dangerously intoxicating. Such a mixture may have been sown and harvested in Italy or in Greece; but this could scarcely happen in this colder climate, as the darnel would not ripen with barley. But it has from the earliest ages borne the name of "*drunken darnel*," and there can be no doubt of its deleterious qualities, whether in meat or in drink.

We have often been plagued with darnel; and the only means we used was enjoining a duty upon the reapers, binders, and barn-men, to collect it in small bundles for the fire, for which a small reward was given. Its early growth is so much like the wheat plants, that it cannot be weeded out by the spud as other weeds are, and of course it stands till reaped with the wheat.

[There is another *lolium*, called *lolium arvense*, described in old books under the English name of *white darnel*; but this is never hurtful among corn, and is only considered as a variety, either of the perennial ray-grass, or of the true darnel. Indeed, there is much confusion in the names of these grasses among farmers. The seeds of darnel, and those of the smooth brome-grass (*bromus secalinus*), are the only two grass seeds found in wheat; and these are indifferently called *ray* or *darnel* by farmers, few being aware of the difference, though they may be easily tested by the taste, the one having the flavour of the oat, the other larger and as bitter as gall. That farmers should be ignorant of what darnel really is, cannot be wondered at, as it is quite evident that neither Sir J. E. Smith, Mr. Holdich, nor Mr. Sinclair, ever met with the plant in this country.—ED.]

2. DRANK, or drauk (*bromus secalinus*). Smooth Brome-grass. Panicle spreading, slightly subdivided below; spikelets ovate, about ten, distinct, somewhat cylindrical; florets smooth; awns wavy, shorter than the glumes; leaves slightly hairy.

Bromus mollis. Soft Brome-grass. Panicle erect, rather close, compound; spikelets ovate, downy; florets imbricated, depressed, ribbed; awns as long as the glumes; leaves and sheaths very soft and downy.

The former of these bromes is an annual plant, being in growth and appearance similar to corn, until it puts forth its characters of fructification. It really gives no trouble, for it generally grows (where it does grow) thinly scattered, and you cannot weed it out. It is true, that it is seldom found but where it is sown with the seed corn; but where you sow it you are sure to have it in the crop. The soft brome-grass perfects its seed earlier than the *drank*, or smooth ray brome-grass, and the seed, for the most part, is shed before the harvesting of corn crops.

About the time that corn comes in ear, or rather later, the *bromus* throws out its flowering panicles, which, as the corn ripens, droop, each spikelet with its heavy load of seeds; these drooping spikelets are somewhat short, and nearly smooth, with the seeds thereon crowded, and the spikelets flat. When ripening, the leaves drop away, and the straw looks clear and handsome, much like good bright oat-straw. The seeds resemble the boldest and best seeds of good ray-grass, but are thicker and much heavier; they contain a large quantity of nutritious flour; and fowls, pigs, and horses, are very fond of them.

The objection to *bromus*, with the miller, is, that it grinds tough, and perhaps somewhat soapy, so as to dull the stones. A very plump and dry sample of wheat is readily saleable, though with a *little* in it; but a sample rough in hand, is lowered in value from a shilling to eighteen pence per quarter. Great care ought to be taken not to sow these



Agrostemma githago.
P.B.



Trifolium pratense.



Eryum tetraspermum.

seeds with wheat; in any spring crop I have never seen it grow. The name of *drank* (or more commonly *drauk*), given to this weed as being common in Norfolk, is a name by which this grass is known and called in many parts of England.

In the central counties of England these seeds are called simply *ray*, both by millers and farmers; and though neither like to see it in wheat, they know that it is perfectly wholesome.

3. COCKLE. Corn-campion (*agrostemma githago*). Whole plant, except the petals and capsule, covered with soft hairs; calyx longer than the corolla; petals entire or slightly emarginate, and naked.

A well-known annual weed, of rather an ornamental appearance, bearing purplish red flowers. In spring its leaves are long, downy, and slender, and the plant is strong and conspicuous at weeding time. It grows somewhat tall before it branches, and is in full flower and bearing when the wheat is ripening, growing two feet and a half high. The seeds are very numerous, and contained in bulky capsules; they are black and rough, resembling a rolled-up hedgehog, and are nearly as big as small wheat kernels; they are filled with white flour, and very heavy. The miller's objection to these seeds is, that their black husks break so fine as to pass the boulders, and render the flour specky; also, because the seed is bulky, if there be much in the sample, it detracts considerably from the produce in flour: whatsoever is not wheat, must lower the value of that which should be all wheat.

It is the duty and interest of farmers to meet their customers the millers with clean samples; for the latter never forget to make use of every objection to beat down the price. "I would give you the other shilling if it were not for the *cockle*," is a common conclusion to one of these bargains: so a farmer having a hundred quarters of wheat grown in one field, loses five pounds by *sowing a little cockle*.

[Nothing is easier got rid of than the seeds of cockle, if the proper means are had recourse to. Brass-wire sieves are in common use for sifting small seeds and dust out of wheat, barley, &c. ; but these sieves are too closely woven to allow the seeds of cockle to pass. A cockle sieve is therefore necessary, and will also be found, for other purposes, very useful in a barn. The common brass-wire sieves are woven, we believe, on the plan of *nine wires* to the inch, to discharge charlock and such sized seeds ; but the cockle sieve should have but *seven wires* within the inch, and should be made of somewhat stronger wire. It is a most useful implement. —ED.]

4. MELILOT. *Trifolium melilotus officinale* ; *melilotus officinalis* ; *melilotus officinale* of authors. Common Melilot-clover. Legumes racemed, naked, two-seeded, wrinkled, acute ; stem erect.

This is an annual plant, growing with an upright stem, about two feet high, branched and furrowed. The capsules containing the seed are very tough and wrinkled, growing in bunches ; each capsule is generally one-seeded, sometimes two, but threshing does not dislodge them ; so that, in samples of wheat, the wrinkled capsule is called the seed ; and these are easiest separated by sifting the corn in shallow sieves, to raise the pods to the surface to be picked off.

This is, of all others, one of the most pernicious seeds in wheat, a few communicating a very strong smell to the flour. The plant is addicted to stiff soils, and often grows on ditch banks in the fences : it blossoms yellow. It is very palatable food to all sorts of cattle, and has a grateful odour when cut down and dried. Nevertheless, as a weed in arable land it cannot be too much guarded against, and ought never to be sown with seed corn. Also, it should be sedulously rooted up by weeding in spring ; for where it has once got in the land, it propagates itself by scattering many seeds before the corn is ripe. Hence wheat, on land so infested, should

always be sown on a naked fallow. It must be understood that these hints are given with a view to the common husbandry.

5. TARES (*erum tetraspermum*). Smooth Tare. About two flowers on a peduncle; seeds globular, four in a legume.

Erum hirsutum. Hairy-tine Tare. Peduncles many-flowered; seeds globular, two in a legume.

Two species of wild tares, called the *tine tare* and the *strangle tare*. It is said, that on dry soils, in wet seasons, they have overrun and destroyed whole crops of corn; and it is well known that the seeds of the hairy-tine tare will lie on the ground for years, but only vegetate in wet summers. They are the favourite food of the turtle-dove. The wild tares are not common, and the seeds of them are much too small to be mistaken in samples for the cultivated sorts.

The miller's objection to these seeds is, that they have a strong taste when ground in the flour. Hence it seems to become an important consideration, whether field tares should be suffered to go to seed, or rather to be fed off, and ploughed down soon enough to prevent it. Also, for soiling, small patches may be set apart, and seeds, at last, may be raised therefrom. For it seems to be a doubtful advantage in agriculture, that the introduction of tares should overrun our fields with new enemies.

The cultivated tares are very common in samples of wheat and barley in the market of Peterborough in Northamptonshire. Perhaps in other places they may not yet prevail, and the farmers will do well to avoid them by all means. It must be unpardonable neglect to sow them with seed corn, but if they come of the general cultivation of the plants, the matter is much more serious.

6. WILD OATS (*avena fatua*). Bearded Wild Oats, or Haver. Panicle erect, compound; spikelets pendulous;

florets about three, shorter than the calyx; bristly at the base, with an oblique scar, all awned.

This weed used to abound on stiff clays, in open fields: the fallows were generally free from it, and only brought the land, about Michaelmas time, in moderate condition for this weed to grow and come up with the wheat. Accordingly such abundance of it would come, that at harvest the whole crop would appear to be wild oats. I once knew a farmer, who, in thrashing out a stack of wheat, dressed out of it fourteen or fifteen coombs of these oats: this was during the war, and in a great dearth of oats; and he actually sold them for horse-corn, at about 28s. per quarter. Wild oats are seldom found but on clays and stiff gravels: on all loose soils, on dryish turnip land, on sandy soils, and on fen and marsh land, they are rarely seen. The seed is somewhat larger than common oats, of a dark brown colour, and having a very rough awn or beard. Of course millers may very well object to them; for when many prevail in a sample of wheat, they occupy a considerable portion of the measure. It does not appear that in spring these weeds can be sufficiently distinguished from the wheat plants to be selected and weeded out, which is also the case with darnel, and is the more to be lamented, because the best system can hardly be expected to eradicate those weeds, in regard to which the hoe and the hand cannot be brought in aid of the fallow and row culture. But this ought to be strictly attended to, as being the strongest argument possible, why these seeds should not be sown with seed corn. So far, the farmers who pay attention are masters of these weeds; and it must be a wilful neglect not to act accordingly.

Throwing the corn from one end of the thrashing-floor to the other is a good plan to get the wild oats separated, their lightness causing them to fall behind the heavier corn.

7. HARIFF (*galium aparine*). This weed has many other names — Goose-tongue, Cleavers, Goose-grass, &c. — by one or other of which it is probably known everywhere. Leaves eight in a whorl, lanceolate, keeled.

rough, fringed with reflexed prickles ; stem weak ; fruit bristly*.

It is said that geese are very fond of it ; and so they are ; and cleavers are by far the best vegetable food which can be given to goslings as soon as hatched.

Hariff is a very scrambling weed, and runs to the length of seven or eight feet, increasing in weight of branches and foliage as it obtains the light, and gets through whatever it grows with. It is, however, principally addicted to deep, loose soils, mellow marshy land, and the drier sorts of fen land. All lightish loams may have hariff, but it abhors clay, and fen soils lying damp and low are not friendly to it. In many clay countries it is probably not known, though it be one of the very worst weeds where it abounds. The farmers of clay lands on the verge of the fens, often buy their seed wheat of the fen farmers ; and they heed not the seeds of hariff, for, if they grow, they come to no length, and are never seen at harvest.

This weed increases excessively on loose, deep soils, when once introduced ; its seeds are round, with a channel on one side, as if rolled up. They are exceedingly rough, and adhere to whatever woollen stuff they touch, so as not to be easily dislodged. Seed corn having burrs (as the seeds of the cleavers are called) in it, if thrown on a large piece of baize cloth, will attach all the burrs and clear the corn. They are also heavy enough to resist dressing, and big enough to escape the screen. Botanists tell us that they may be roasted instead of coffee ; but unless children gather them out of hedges for this purpose, they cannot be obtained separate from other rubbish.

Without doubt, when roasted, they would grind ; but raw they are the toughest of all seeds in agriculture. Millers may very rationally object to them, for, if they be numerous, they will almost make the stones whistle. In samples of oats they are abominable ; horses can scarcely grind them.

* This common weed has been found wild in the remote country of Nepal, by the Hon. Captain Gardner, from whom Dr. Wallich sent Sir James Edward Smith specimens.

How to destroy this weed, is, how to destroy all annuals, namely, by encouraging the seeds to vegetate, and killing them with the plough. However, as it chiefly infests dry and deep soils, or black-mould land, it may be useful to the *amateur* to show by what rotation it may be effectually subdued. Suppose a quantity of this weed to grow with a crop of oats; after harvest, as rains come on, the scattered seeds will very numerously vegetate on the surface; this will be much encouraged by getting off the stubble, and harrowing; when the opportunity occurs, plough the land a shallow tilth, and harrow it again. Much surface rubbish may now be raked and carried off, and the land lie till spring. After spring seeding, plough this piece a seed furrow pitch, and harrow it; clean it from twitch and roots, and let it lie to be green over with annuals. It may then be manured, and the manure immediately ploughed under. After a little harrowing and handpicking the twitch, the land may lie till you choose to sow it; the best crop is *rape* if the land be light, which should be sown rather late (about the beginning of August), and perfectly well hoed and cleaned. The crop may be stocked with sheep in February, but not eaten too close down. The surface, as the spring advances, is to be kept clean with hoes, and the rape is to stand to be threshed; after which the surface must be discharged of the stalks by pulling, and the land may be sown with wheat at once ploughing. This crop may be cleaned with a little exertion by weeding; and in the spring sow the land well down with the best mixture of grass seeds that can be procured. Though light land does not suit wheat, especially as to quality, yet depth and penetrability of subsoil will generally give you produce enough. It grows too tall and flaggy, and is easily brought down with wind and rain; but if it be clean it will make good seed for other soils; and you can by no other means obtain so much profit, *without deteriorating the soil*, by any other rotation of the crops.

This argument might be beneficially extended, as it applies to the cultivation of dry black-mould land, of deep texture, having some dry peat remaining, and a clay bottom, too far below to be ploughed up, except in spots and

patches. This land will by no means lie profitably in permanent grass, neither can any four fields of it be rendered convertible, because the continuance of ploughing pulverizes the soil to dust, and the encroachment of the couch requires much exertion to master it. In the state of a dry powder, the soil powerfully resists moisture, and becomes highly infertile, and the weeds overpower all husbandry.

The usual rotation in the drier part of fen lands, is either from paring or burning the grass surface for rape, eaten off by sheep, to oats the second year, and wheat the third year; or Heligoland beans after rape, and wheat the third year. If, with the wheat, the land were returned to grass, no fault ought to be found; but the cultivator will not part with the arable system so soon. After wheat they go to fallow, and here begin the *powder* and the weeds. Fourth year, fallow, rape; oats the fifth year, and then wheat and grass seeds. No management on earth can subdue weeds on light deep soils, with such a system; those which naturally prevail in the soil, and such as may be sown with the crops, are perfectly triumphant. Horse-hoeing is here impracticable, the soil being so light; hand-hoeing and weeding have been followed, to the expense of five or six and twenty shillings an acre, without being able to clean the crop. The mode looked to, is to get a thick crop of corn if possible, and when the crop is a foot high, or more, to put weeders in it, who break off and crop and batter down the biggest of the weeds, and leave the others to contend with the crop as nature and the season may rule. As to hariff, where it abounds, they sometimes drag the crop (if wheat) with a horse-drag. Sometimes the weeders make themselves short rakes, and scratch and tear the crop in pieces, as well as the weeds. These methods never did much good; for that which pulls the corn away, opens the path for the weeds to grow again. Where patches of this weed grow through a thick crop of wheat in spring, nothing better can be done than to crop off the superior shoots within the wheat leaves, and leave the wheat crop as entire as possible, to smother the plants below.

But, after a great deal of experience, which I have had in

the cultivation of dry-bottomed and deep black-mould lands, I recommend short rotations of cropping between longer intervals of grass lay. Nothing else can subdue the weeds, which are so numerous and ramping in such soils.

8. **BLACK BINDWEED** (*polygonum convolvulus*). Climbing Buck-wheat. In some places called Bear-bind; but in the fens simply Bindweed, because such land produces none of the perennial rooted species hereafter mentioned. Leaves heart-arrow-shaped; stem twining, angular; segments of the calyx bluntly keeled. Annual. Flowers in June and September.

This weed is too often a companion to the last: the same soils grow it abundantly where it has got in by sowing, and it runs to as great a length, getting above the corn that is *laid*, and covering the crop by patches.

The seeds are brown, triangular, hard, and smooth, and quite as nutritious as buck-wheat. They are heavy, and large enough to resist dressing, and in wheat samples are objected to for the same reason as cockle. In oats they are really no objection to the buyer, horses being very fond of them. The farmer, however, has just reason to stand in fear of this weed, from the destruction it brings to his crops, and the injury done to the samples.

9. **SHEPHERD'S NEEDLE**, Venus's Comb, or Needle Chervil (*sandyx pecten veneris*). Called also Beggar's-needle and Crow-needles. Fruit nearly smooth, with a bristly-edged long beak; umbels simple, solitary, or in pairs; bracteas jagged; petals inflexed at the point. Annual. June, September.

This is a bushy and troublesome annual in barley crops; the seeds are long and bent, of a rough texture and brown colour. They are seldom seen in samples of wheat, being a little too short of growth; but barley, being mown, must necessarily be infested if they be in the crop, for no dressing can separate them. I was told in Hampshire that *they never weed their barley*: but whether their flinty and calcareous soil be much suited to this weed, I do not know; certainly

there were many tall *horse knaps*, and a sprinkling of *thistles*, *docks*, *wild carrots*, and such things, standing bolt upright when the barley drooped with ripening. I doubt very much whether any more weeding will be done in consequence of the writing of this Essay : the breadths sown are very large, and I suppose they have not women and children enough in the villages to do what is wanted.

10. ANNUAL SNAKEWEED (*polygonum lapathifolium*).

Pale *Persicaria*. Styles two, distinct; stamens six; flower stalks rough; stipulas beardless; seeds concave on each side.

Called in the fens willow-weed, where it is one of the worst weeds they have. It grows very freely on all loose and deep soils, and on marshy lands, though it be scarcely known to any of the cultivators of clay, and it is as rarely to be seen on any sort of turnip land; so that the greater part of farmers will not be able to comprehend what plant is meant. Botanists know it very well, but they do not know it to be a destructive weed; accordingly, in Mr. Pitt's Essay it is omitted.

This plant grows from one foot to near three feet high, but commonly from eighteen inches to two feet. Its stalks are pale, or spotted, or reddish, the joints much swoln, and the stalk appearing tender and succulent (something like that of the balsam). The plant branches much when it has free growth, and produces a great number of crowded spikes of seed. The leaves resemble those of the willow, but are charged with dark spots in the middle. The seeds are very bright and heavy, round one way, but flat and indented on one side; the colour is black. This plant belongs to the same genus in botany with buck-wheat and black bind-weed; and its seeds are highly nutritious, and very grateful to birds, especially partridges, lapwings, &c.

These seeds very much infest samples of fen corn, whether wheat, oats, or barley. The skreen, indeed, discharges much: and, with pardon be it spoken, I have seen sacks filled with it, and shot into a dry ditch. Those who keep

decoys for catching wild ducks, will buy the seeds to feed and entice the fowl. Pigs will do well on them, if boiled.

As a weed, in fen soils, it is the most ramping and cumbersome of any weed that grows. Its seeds abound in the soil, and increase by scattering from each crop, so that in many cases, by spring cleaning, the whole surface is covered with the plants; these are usually ploughed down, and the land sown upon the second earth; but often as many more appear, and very much injure the crop. In 1821, a piece of loose, low land, in the newly enclosed fens of Peterborough, was sown with oats and ray-grass; but this weed usurped the soil, and spoiled the crop. The next spring, when the field should have been grass lay, these seeds again rose so thick as to cover the field entirely, excepting a few patches. The land had sheep put upon it to eat what grass there was, and the crop of weeds was left to stand till autumn. During a great deal of the summer, the sheep could not be easily found in the *cover*: and when mown down, being then dead and ripe, the swarths lay like peas and beans, sending forth a strong and peculiarly bitter smell. This crop might supply the soil with a stock of seeds, at the rate of twelve bushels to the acre.

Of course this was not the way to destroy snake-weed, or willow-weed; but all fen soils contain a great deal of it: when they come again from grass, to be pared and burned, as much as lies to one inch and a half deep will be consumed by the fire. Some will grow (with other weeds) in the rape; oats the second crop, at once ploughing, is generally a thick and quick growing or smothering crop; not many weeds can contend with this crop, and weeders may easily subdue them. In autumn sow wheat on the oat stubble, and in spring sow grass soon enough: roll well, and weed well; and if you have not destroyed much willow-weed, you have done the next best thing, that is—*hindered it from growing*.

11. CHARLOCK.

It scarcely deserves mentioning, that these seeds are found in samples of corn at all, because a skreen will separate

them completely, they being so minute ; they will therefore be more particularly mentioned hereafter. Of these eleven weeds, whose seeds infest samples of corn, five are principally injurious to wheat ; the others are partial, and more common in barley and oats.

12. HORSE GOLD (*ranunculus arvensis*).

This species of frog-wort or corn butter-cup is an annual, or rather, perhaps, a biennial, as it is sown and reaped with wheat. The stem is erect, about a foot and a half high ; upper leaves decomposite, segments narrow ; flowers small, pale yellow ; seeds flat, convex on one side, concave on the other ; about one-sixth of an inch in diameter ; edges fringed with crooked prickles, with which the seeds attach themselves to the fur or wool of animals. When this plant is threshed with wheat, the seeds appear in the sample ; and from which they are not easily separated by the common means. Wheat containing these seeds cannot be sold, nor should they be used for seed, and the miller is sure to object, as they belong to an acrid and dangerous family of plants. When met with, they should be thrown out of the sheaves by the reapers.

CHAPTER II.

OF FALLOW WEEDS.

THE distinction of fallow weeds is not made as if all surface-rubbish, and the seedlings which grow, were not to be also destroyed by the fallow; but rooted weeds, and a few others, deserve to be particularized, and treated as objects to which attention ought to be drawn. After all which has been said about pulverizing the soil, that the *seedlings* may vegetate, this has never been the object of any fallow. In clay land, and all stiff loams, every exertion is made to break the soil down as fine as possible; but the weeds grow incidentally, and according to the season, and must be destroyed *if they grow*. In all light soils, a high state of pulverization is unavoidable, because while they are working out the couch, the other necessarily takes place. But whether many seedlings shall grow, depends on the moisture of the season, as before. Mr. Pitt says, "I have observed, that wet weather is as necessary as dry, to give a summer fallow its whole effect." Meaning, that the frequent showers encourage the germination of seeds, and as plants are destroyed by the next ploughing. Most farmers may have observed the same thing, though they cannot alter the weather; but in waiting and wishing for rains, all hard land farmers look more to the pulverization of their fallows than to the vegetation of their annual weeds. The only observation of any practical importance is, that *clay fields for fallow, ought, if possible, to be autumn-ploughed*; because in spring you may be obstructed by drought, and be prevented from attaining the necessary pulverization. Couch is very hard to kill in clay; it will scarcely ever draw; and in

breaking down the soil, every division of a clod into two parts often leaves a piece of couch running through the middle of each. In wet seasons no good can be done; and as far as regards the real objects of fallowing, dry weather on the whole is the more favourable. In every fallow, a great many annuals are destroyed of course; but in those which are less complete, whether it be from the farmer's inattention or want of power, or from the interruptions of too much wet, much worse things are left behind than the seeds in the soil. In point of fact, there can hardly ever be above *one extra ploughing required to turn down seedlings*, on any soil, and in the most favourable season.

Modern writers have treated this subject as if *pulverizing* were a new object in fallowing; or as if the seedlings of weeds did not always grow with pulverization; or, thirdly, as if all the seeds of annuals which the soil contains might be easily destroyed by due attention to this object. In truth, it is no such thing; for some years these extra exertions (if extra pulverization be effected) would fill the *crops* with a more abundant growth: and if these be all killed by the hoe and the hand, and clean husbandry accomplished, and so continued, the number of seeds must diminish, and the labour would at length be mitigated. Nevertheless, this is wholly impracticable on poor soils, where weeds most abound, because the crops will not pay the expense; and on obstinate clay soils it is equally impracticable, because the drill system cannot be efficiently worked thereon.

The objects of a fallow are, and always were, 1st, To eradicate root weeds, and cleanse and open the soil to the fibres of future crops. 2dly, To pulverize and break down the texture of clay soils, and mix them with manure, in order to bring the land periodically into a mild and fertile condition. The convertible, or turnip system, introduces no new object in fallowing; the soils being lighter, the business is accomplished in shorter time; therefore turnips are sown with the manure, and the land has thus a double advantage in the renewal of its fertility; at the same time returning a valuable crop for the expenses incurred. Seedling weeds are destroyed incidentally; and good fallows, with good

seasons, kill a great many, though it be not the object of fallowing.

The fallow weeds are principally such as follow:—

1. Couch; 2. Rest-harrow; 3. Saw-wort (the common Way-thistle); 4. Curled Dock; 5. Tall oat-like Soft-grass; 6. Colt's-foot; 7. Corn-bindweed; 8. Corn-mint; 9. Surface-twitch; 10. Black-grass. Many others might be added; but if these be subdued, the others must be killed of course.

1. COUCH (*agropyrum repens*). Calyx valves pointed or awned, lanceolate, many-ribbed; florets about five, sharp-pointed, or awned; leaves flat; root creeping.

Until of late years, that botanical science has afforded us better information, it was generally supposed that all couch or twitch was of one sort, or the roots of one species of grass. But many persons observed that some of these roots, on wet soils, were *black*, and much smaller, and they had locally obtained the name of *black twitch*. Queries have also been sent to the Farmer's Journal, "What is black twitch?" In fact, the black twitch, on soils where it prevails, is much worse than the other, because it is wiry and small, and not so easily discharged from the soil; it is also more brittle, and by harrowing breaks short. It is called

Agrostis repens. Panicle scattered; branches bare at the base; florets few; calyx, inner valve smooth; root creeping.

There are two other grasses which have strong creeping roots, and are indifferently called couch; these are the *holcus mollis* and the *poa pratensis*: they may locally abound, but, as far as my knowledge goes, they are not so common as the *agropyrum repens*.

Holcus mollis. Creeping-rooted Soft-grass. Calyx partly naked; lower floret perfect, awnless; upper with a sharply bent prominent awn; leaves slightly downy; root creeping. Flowers in June and July.

Poa pratensis. Smooth-stalked Meadow-grass. Panicle



Brassica
P. 46.

napus.

Spargula arvensis.
P. 47.

Polygonum convolvulus.
P. 48.

spreading; spikelets four-flowered; florets lanceolate, five-ribbed, connected by a web; stipula short and obtuse: stem and leaves smooth; root creeping.

With respect to destroying couch there can be but one way; that is, by ploughing up the soil and pulverizing it.

If there were no fallow weed but couch, as far as British husbandry is concerned, fallowing would be quite as necessary, and much the same in operation, as it is at present. Under every rotation of crops, with the best management possible, couch accumulates in all soils. The very best fallow must leave some; with the barley it kindles and shoots, and the clover year foster its growth. If then you have wheat at one ploughing, it is seldom wise to break up the tilth, but rather to harrow it lightly down, and drill the seed upon the unbroken furrows: surface hoeing destroys annuals, but has nothing to do with eradicating twitch. Hence, after the wheat the fallow becomes as necessary as before; and this must be always so. On clay soils, according to their quality, whatever the rotation be, fallows are still more necessary, because of their cohesive nature. Twitch does not work so freely on stiff land, nor does it accumulate so much; but here the labour, which might be slighted if destroying couch only was considered, is necessary to pulverize the soil, as an indispensable principle of fertility.

By our ancient system of fallowing open-field lands, it does not appear that destroying weeds was much in their thoughts; nor had the great benefit of pulverization on clays attracted their attention. They broke up their fallows in May and June, sometimes so hardened, and in such immense lumps, that the rest of the summer did not dissolve the clods; nor, with the assistance of their abortive operations, was the soil half broken down as it ought. Nevertheless, their sole objects appeared to be, to break down the soil, and mix it with manure in preparation for sowing their wheat. At any rate, as the breaking down was frequently incomplete, the *cleansing* must have been abortive, if they had it in view.

The modern dispute about the utility of fallowing, is founded on this point:—that perfect and sufficient pulve-

rization on heavy soils would enable such soils to produce a root crop with the fallow (as potatoes), and the land would go to wheat in a better state than without such crop. This argument is true, *as far as heavy soils are rich*. A great deal of such land, very ill-managed before, by more expense and exertion, has proved the fact; but this is the same thing as saying that such lands were capable of a better and more profitable rotation. The rule does not extend to cold clays, and especially not to such as are very wet; so that the anti-fallowists have proved nothing, and fallowing remains an indispensable part of husbandry, and will for ever.

It may, however, be added here, that in many cases of fallowing, a summer crop may be taken from off a fallow, with not only advantage to the farmer, but with positive advantage to the land, by keeping it shaded from the exhausting effects of the summer sun. It is very seldom that a stiff clayey soil, though fallowed up in the autumn, and well ameliorated by winter frosts, can be sufficiently worked in the spring, and cleared of couch and other root-weeds soon enough to receive a summer crop, to be cleared off before wheat seed time. But with lighter descriptions of turnip land, which may be perfectly cleaned and ready for the dung cart by the 1st of June (and ultimately intended for fallow wheat), may be very properly sowed with yellow clover to be folded off before wheat seed time; or with brank, for a crop which will come off early in October. Under either mode of management, the land being *shaded* during the dry months, will be of signal service to the wheat crop, whether or not any advantage be derived from the *stolen* crop.

Repeated and unnecessary ploughings of fallows, during a dry summer, deteriorates the soil much more than is commonly imagined. The humid riches of a soil are fugitive under a hot sun, or drying air; and therefore, the less the ground is stirred, if free from weeds, the better it is for future crops.

A new idea respecting the real use of fallowing has been lately promulgated by some French philosophers, and which is at complete variance with the notion above hinted, *viz.* that the sun and drying winds draw out the best qualities of

the soil. On the contrary, it is asserted, that land which has been previously cropped, actually requires *bleaching* by the sun and air, to free it from noxious exudations discharged by the roots of previous crops; and which act as poisons to plants of the same species. It is thus that these philosophers account for the difficulty of growing crops of the same kind consecutively: why broad clover, or any other crop, *tires of the same field*: and moreover, the only cogent reason that can be given for the necessity of a constant change, or rotation of crops.

There may be some truth in this new philosophy, but it is not yet generally received. Though there can be no doubt of the necessity of fallowing, in order to clear the soil from weeds, or to get it into a proper state for the reception of seed, yet it is a well-known fact, that the more a light soil is ploughed during summer, the less capable is it of bearing a heavy crop of corn, unless recruited by an adequate supply of manure.

2. REST-HARROW (*ononis arvensis*). Called also Cammock. Flowers axillary, in pairs; leaves ternate, upper ones solitary; branches villose.

I should not have set this down as a fallow weed, had not Mr. William Pitt, of Wolverhampton, mentioned, in his Essay on Weeds (printed in the 5th vol. of Communications to the Board of Agriculture), that it is common about Wolverhampton. He adds, "But if the root can be destroyed in the fallow, there is little danger from the seeds." Though Mr. Pitt, by several of his articles, was not an agriculturist, yet he understood botany very well, and must be allowed to know what was *common about Wolverhampton*. There can be no doubt but that the rest-harrow and the thorny rest-harrow (*ononis spinosa*), were common annoyances to the operations of agriculture a hundred years ago, but I should have thought them now confined to wastes, banks, and warrens. The names *petty whin* and *ground furze*, given to the thorny species, will indicate to the reader its resemblance to gorse (*ulex Europæus*); but the flower is nearly white, and the plant trails on the surface. It is quoted by Dr. Withering, from

Mr. Woodward, "That he examined some hundreds of plants of the *arvensis*, in the corn fields, at Berkhamstead, in Hertfordshire." The plant of course is shrubby and perennial, but it deserves to be closely examined into, why it is that the roots are not destroyed by fallowing? Is it owing to the great depth to which they penetrate, or to their fibrous minuteness, like nettles? Also it seems to require consideration, that in a very great number of fields it has certainly been destroyed; and why, therefore, it should yet be common in others? The rest-harrow is still met with in poor gravelly soils, which have been long arable. It escapes both plough and harrow, from the extreme toughness and length of its root, requiring a mattock to grub it up.

3. SAW-WORT (*carduus arvensis*). Leaves sessile, pinnatifid, spiny; stem panicled; calyxes ovate, spinulose.

The common way-thistle, or pasture thistle; but also a very bad perennial weed on rather light loams, and loose, strong soils. Indeed, it grows almost everywhere, and loves mellow clay, and seemingly wet clay quite as well; but it is more easily subdued on good strong loams than on such soils as are either very loose or very wet. It seems quite impossible wholly to destroy this weed by any exertions of tillage which are consistent with due attention to profit. We can do no better in any case than give a good naked fallow; after which a good many of these weeds may rise the next year with the wheat; for that season they should be carefully *hand-weeded*, if the soil be open: if it be clay, they will not *draw*, but must be cut close with a spud. If neglected, there is no weed more unsightly or injurious; the second growth, on loose soils, often gets into the reapers' hands; but the first, if not destroyed, will overtop the wheat, bearing innumerable clusters of flowers, and shedding their winged seeds in most noxious abundance.

The roots of this weed are sometimes called *vermicular*, but whether this is because they creep invisibly, and spread in an unaccountable manner, is not mentioned. We have generally understood *vermicular roots* to mean those creeping roots which are very crooked, and lie much curled together,

as in the great hedge-bindweed (*convolvulus sepium*). I have observed the roots of the thistle to be often curled up, but it has always been in a dry crack in the clay where they could not get out. I believe the roots of thistles, the living roots, can seldom be seen or found, much less picked out, in a fallow. If they have horizontal roots, they lie deeper than we can plough: and, indeed, something of this sort might be suspected, because the spring and summer plants, especially on loose soils, often draw with a tap root (an annual root) a foot long, or more, still leaving part behind. However, this root or *descending* caudex may strike down, from midway or higher, in the cultivated soil, as the *ascending* caudex or stem rises. I have found on light rich soils, in spring, a great many small thistles, as it were, bursting from their matrix, and have gently pulled the horizontal zig-zag roots from the soil, with many green buds and shoots just appearing. These roots were jointed, white, and of a very succulent texture. This, therefore, is the manner of their reproduction: the fibres left, shoot out larger roots, which also rise higher in the soil, and spread; these form buds, and hence come our annual crop of thistles.

Now, what is the inference from the facts, that couch-grass and thistles can by no means be extirpated? Is it not perpetual exertions, fallowing, and agricultural labour? Some may be inclined to say, "A melancholy reflection!" — But I say *no*—not at all. Providence could not have better contrived than that exertions should be perpetual, and that *success* should be in proportion. There is not a weed that we ought to wish out of our fields, unless we remove and destroy it; because, if there were none, or very few, all fields would be clean, and no praise could light on superior modes of tillage. Some may say again, "So much the better!" — But I say *no*:—Does any man think that our various soils would have been sufficiently pulverized and worked, had there been no enemies of this sort to challenge forth our labour? Sterility would have seized on our turnip lands, which are only continued in a state to bear their relations of crops, by the necessary periodical renewals of their fertility. So might all our clays have gone to perpetual

grass, for neglect of proper tillage would have rendered them unprofitable. "By the sweat of thy brow thou shalt eat bread," is an ordination of the highest authority, and the fulfilment of it is that precise principle which puts all mankind in motion. The necessity of subsistence produces industrious hands for every department of labour; but the sluggish nature of man requires every stimulus to exertion. The weeds of the fields excite emulation among farmers, and foul fields are always a reproach to the occupier. Thus we are compelled, by an unseen hand, to better habits and more active industry.

Clearing the wheat of thistles by the hook or spud, is usually practised during the months of April and May. But to show of how little avail it is to cut down thistles early in the year, the following rustic doggrel may be subjoined:—

" If thistles be cut in April,
 They appear in a little while;
 If in May,
 They peep out the next day;
 If cut in June,
 They re-appear very soon;
 If in July,
 They'll hardly die;
 But if cut in August,
 Die they must!"

Now although we have known many deeply-worked summer fallows fail to destroy thistles, yet we have known a very foul field cleared of them entirely by *once* fallowing; and which was attributed to putting in the ploughs at the very nick of time the roots were making a fresh shoot; and particularly just before making their last summer shoot—say about the beginning of September.

4. **CURLED DOCK** (*rumex crispus*). The Common Dock of clover fields. Petals permanent, ovate, entire, all tuberculated; leaves lanceolate, wavy, acute. Root perennial; flowers in June and July.

To avoid this pest, farmers should be cautious not to sow clover seeds which have the seeds of the dock intermixed.

The seeds are triangular, bright brown, and heavy; and so near the size of red clover seed, that they cannot be separated by sieves. In some seasons we get good ripe seed from clover eddishes, and this is always free from docks, because these weeds do not form a second seed-stem in the same summer; but I am afraid that *maiden seed* (seed from the first growing) is rarely quite free. But this really seems to be a point of inexcusable neglect, because the dock plants are sufficiently large and conspicuous to be either drawn or spudded, before the clover is too high to walk in.

Dock seeds do not infest corn samples; it rarely happens that they are seen even in barley, because the turnip fallow is quite capable of rooting them out. If otherwise, and they are suffered to seed in the barley crop, it must be very bad farming, because no weed can be more distinctly seen when weeds ought to be pulled out.

5. TALL OAT-LIKE SOFT GRASS (*holcus avenaceus*), or Tall Oat-grass (*avena elatior*). Calyx smooth; barren floret lowest, with a sharply-bent prominent awn; fertile, one slightly elevated, scarcely awned; leaves rather harsh; root knotty; flowers in June and July.

This grass is a noxious weed in arable lands, though not so in pastures; indeed, as an ingredient of permanent pasture, it possesses sufficient merit, in respect of early growth and produce, to entitle it to a place in the most valuable pastures — such, however, as are never intended to be converted to tillage. Mr. Pitt includes this among the *twitch grasses*, but its roots do not creep in like manner; they are properly tuberous, and, increasing in the soil, they are hard to destroy. These tubers often subsist in great quantity where there may be but little *couch*, but at least as much fallowing is required to remove them. In fact, as the bulbs may not all hang to the congeries of fibres to which they belong, many loose ones, though ever so lightly covered with soil, will escape; it being manifest, that such small things cannot be picked out, excepting as they hang to something.

This weed has been found very prevalent in some parts of the North of England; but wherever it prevails, it ought to

be carefully rooted out, for the plant it bears is tall, strong, and cumbersome, capable of contending with any crop, and often grows taller than the corn. Besides, it has a tendency to take absolute possession of the soil; and, if once in possession, it is most difficult to eradicate. In wet, clayey, arable soils, where, through neglect, this weed abounds, the only remedy is paring and burning the surface of the land, and afterwards giving it a naked fallow. The row culture, and liberal use of the horse-hoe, being adopted in every succeeding crop, will effect the destruction of the weed, and prevent its regaining a general footing in the soil. There is a variety of this grass without awns, described in the Hortus Gramineus Woburnensis; it is also destitute of the knotted roots which constitute the character of *couch*, as regards this grass.

6. COLT'S-FOOT (*tussilago farfara*). Scape one-flowered, scaly; leaves cordate, angular, toothletted.

The roots of colt's-foot creep horizontally far and wide. Every part of the root will produce a plant, and, though buried to the depth of a yard or more, it will vegetate, send up a stem to the surface, and spread out with astonishing rapidity. It will flourish in the strongest clays, in which it is found to be one of the most injurious of weeds, and hard to destroy. The flowers appear early in the spring, and long before the leaves are expanded. Where it abounds, draining should be had recourse to, if the soil be damp; and if clayey, the texture of the soil should be improved by an abundant application of sand, coal ashes, or other warm dividing manures. Paring and burning early in the spring, and followed by a naked summer fallow, will overcome this weed so often complained of by farmers; and the adoption and judicious application of the row, or drill culture and horse-hoe husbandry, will complete the eradication of this vile and troublesome weed. I have completely overcome colt's-foot, by simply draining and hoeing. It was never suffered to produce flowers, or fully to expand the leaves; this plan persevered in, and faithfully executed throughout one entire season, was found sufficient to subdue it. But when suffered to flower, and to expand

the leaves, the increase of the creeping roots went on in proportion, and rendered simple hoeing afterwards for that season of little use. The roots are frequently found deep in the soil, and when it gets established in clayey or marly lands, it is next to impracticable to get rid of it. By deep ploughing and forking out, a great expense is incurred; and, as before observed, should the smallest portions of the roots be left in the soil, plants will be produced from them, and the previous operations of ploughing and forking out will be found to have prepared the soil for the more rapid propagation and extension of these plants. However, if the colt's-foot can be ploughed and forked out at a reasonable expense, it will assist more effectually the practice, recommended above, of destroying the plants, by never suffering them to flower or to develop their leaves, which may be effected by the hoe when the land is under an annual crop, provided the row culture be adopted.

CORN BINDWEED, Small Bindweed (*convolvulus arvensis*). Leaves arrow-shaped, acute at each end; stalks mostly single-flowered; bracteas minute, remote from the flower. Root perennial. Flowers in June and July.

The root penetrates to a considerable depth in the soil, and creeps powerfully. Light sandy soils are most subject to it. Corn bindweed is as difficult to extirpate as colt's-foot: and when it once gets introduced into the soil, whether in grass or in tillage land, it is found to be unconquerable by the ordinary modes of weeding. The stems entwine round and choke the plants of corn, pulse, or grass. Every portion of a broken or divided root will grow and produce a plant; it vegetates rapidly, and spreads in every direction. By never allowing the young shoots to develop the leaves, but by hoeing on their first appearance above-ground, in the course of one season the roots will be found so much exhausted, as to yield afterwards to the drill culture of crops, provided the principle be acted on of using the hoe, so as to prevent the shoots of the plants from expanding their leaves. The mode recommended for the speedy and effectual de-

struction of colt's-foot equally applies to corn bindweed. Paring and burning the surface, however, recommended in the former case, will not be advisable here, as the light sandy nature of the soil in which bindweed prevails would suffer injury in its texture from the process. But a naked summer fallow, with due attention to deep ploughing, and careful forking out of the roots of the weed, are essential to begin with, and the row culture and persevering use of the hoe ever afterwards followed.

1. WILD CARROT (*daucus carota*). Bristles of the seeds slender; leaflets pinnatifid, with linear-lanceolate acute segments; when in seed concave. Root biennial; flowering in June and July.
2. HEDGE PARSLEY (*torilis infesta*), sometimes called Dill. Umbels of many close rays; general bracteas scarcely any; leaflets pinnatifid; branches spreading. The seeds are destitute of ribs; covered irregularly with ascending, awl-shaped, shortish, rigid prickles, or partly with blunt, prominent, crowded granulations; the *juncture* channelled, close.
3. COMMON FOOL'S PARSLEY. Lesser Hemlock (*æthusa cynapium*). Leaves uniform; leaflets wedge-shaped, decurrent, with lanceolate segments. Root annual; flowering in July and August.

The seeds are ovate, moderately convex, with five rounded, acutely-keeled ribs, and deep acutangular interstices; their inner surfaces dilated, flat-marked with a pair of coloured longitudinal lines, and closely pressed together.
4. SPINGEL or FENNEL (*meum feniculum*), or Common Fennel. Leaves triply pinnate; leaflets awl-shaped, drooping; bracteas none. Root biennial; flowering in July and August.

The names wild carrot and dill are often applied by husbandmen to the above four plants generally; the third, or

fool's parsley, is considered dangerous, or possessing poisonous properties. As weeds, they are not of a very troublesome nature. Some of the seeds, together with that of the common dock, not unfrequently infest samples of red clover: those who please, as they walk in their fields, may examine the seeds of the wild carrot, by rubbing them in their hand, to ascertain whether they be egg-shaped, equal at both ends, quite plump, and rough on the surface, but not so as to adhere to any thing.

When our forefathers had clover seed to sell, they sometimes used to recommend it by saying, "that it had neither dock nor dill in it." The seeds of these plants being sown upon the barley, or being in the soil, escape the weeding of that year, and the next they become strong-rooted plants in the clover, and should be as carefully rooted out as the docks. They are local weeds, and but seldom more than one species is found to infest particular soils; on dry chalky soils the last is (as far as my experience goes) peculiar; the fool's parsley is more common on light cultivated soils.

CORN MINT (*mentha arvensis*). Leaves ovate, acute serrated; stamens as long as the blossoms. Root perennial.

Where the land is moist this weed chiefly prevails: its creeping roots are said to be difficult to extirpate; I have not, however, from personal experience, had to contend with it. It is certainly not a very common or general tillage weed, except on marshy or fenny land, which has been over-cropped; the roots are white, fleshy, and creeping, and bind the soil much in which they grow, obstructing the pulverization; also many of the roots are cut by the plough, and may break from the tops in harrowing, so that patches (for they generally abound in little hollows) ought to receive extra tillage, by turning short with your ploughs and harrows, and so give more exposure. It is said to be overcome and got rid off by correcting the defects of such soils as encourage its growth, by draining, paring, and burning the surface, and adopting the drill and horse-hoe husbandry. This plant is common enough.

SURFACE TWITCH (*agrostis stolonifera angustifolia*).

Smaller-leaved Creeping-bent, or Spurious Fiorin, Red Robin, &c. Panicle crowded with florets at the base and towards the top; florets small; inner valve of the calyx smooth, outer serrulated, corolla without any rudiment of an awn. Perennial; flowers in July and August.

COMMON KNOT-GRASS, or Wire-weed (*polygonum aviculare*). Flowers axillary; leaves elliptic-lanceolate, rough-edged; ribs of the stipulas distant; stem procumbent, herbaceous. Annual; flowers from April to October.

The root is fibrous, long, very tough, and somewhat woody; branched below; stems many, spreading in every direction, generally prostrate, much branched, round, striated, leafy, with numerous knots or joints. This and the preceding are indifferently called surface twitch, or red robin, by farmers; on examination, one will be found a species of the natural grasses, and the latter a species of buck-wheat. They are mischievous weeds among broad-cast sown corn and turnip crops, particularly in the early stages of the growth of such crops. How to destroy these, is merely to adopt the drill and row mode of culture, to keep the land fertile by judicious manuring and cropping. Poverty of soil and neglect of the hoe, or its imperfect use in the broadcast sowing mode of culture, are the great encouragers of surface twitch.

BLACK-GRASS (*alopecurus agrestis*), also called Black-bent, Spear-grass, Slender Foxtail-grass, &c. Culm erect, roughish; spike racemose, nearly simple, tapering; calyx glumes almost naked, combined at the base, dilated at the keel. Annual; flowers from July till November. This annual and noxious species of foxtail-grass is distinguished at first sight from the valuable permanent pasture species, meadow-foxtail (*alopecurus pratensis*), by the want of woolly hairs on the spike, so conspicuous in that of the *a. pratensis*.

This weed produces an abundance of seed, which attracts the smaller birds, as well as pheasants and partridges, which are fond of the seeds. It is execrated by farmers under the names of black-bent, black-grass, spear-grass, &c. It is most prevalent in poor soils, or rather such as are reduced to poverty by hard injudicious cropping. Although an annual, yet it is most difficult to extirpate, for it sends up flowering stalks during the summer and autumn; cutting it down, therefore, previous to the time of its flowering, or of ripening the seed,—an effectual remedy for most annual weeds,—is not of avail with this. It can bear to be repeatedly cut down in one season, without suffering essentially by the process.

It has already been remarked, that the appearance of black-bent among wheat, is a certain sign that the crop will be light and worthless. It rises on poor loamy gravels, that have been sown when in too wet a state: and it is remarkable that it only appears on strong clays which have been sown when too dry. It is seldom seen where a superior style of farming is carried on: and this, which is always most profitable to the farmer, will be found the best remedy for removing, as it will be the best preventive of its intrusion.

GREAT ROUND-HEADED GARLIC (*allium ampeloprasum*).

This is a most noxious deep-rooting weed, in some of the deep clayey loams of England. The stem and head of the plant is reaped with the corn, and if also threshed together, the rank and disagreeable scent of the garlic is conveyed to the grain, rendering it almost unsaleable. The roots lie far below the range of the plough-share, and are therefore difficult to extirpate by the ordinary processes of fallowing. Luckily this wild garlic is but locally distributed, and by no means a generally prevailing weed.

CHAPTER III.

OF THE WEEDS WHICH ARE PRINCIPALLY OBJECTIONABLE AS THEY ENCUMBER THE SOIL, OR WHOSE ROOTS ARE ANNUAL, AND WHOSE SEEDS PASS THE CORN SIEVE.

OF this class of weeds, the following deserve particular notice:—1. Charlock; 2. Corn-poppy; 3. Blue-bottle; 4. Mayweed, or Mather; 5. Corn-marigold.

1. CHARLOCK.

This weed was before alluded to, when speaking of those weeds which infest samples of corn; but as the seed is sufficiently small to pass through the corn-sieve, its presence in samples must be owing to careless winnowing. There are four different species of plants confounded under the name of charlock, *viz. sinapis arvensis*, or common wild-mustard; *sinapis nigra*, black or Durham mustard; *raphanus raphanistrum*, wild radish; *brassica napus*, wild navew: this last is the least common.

Sinapis arvensis has pods with many angles, swollen, and bulged out by the seeds, smooth, longer than the two-edged beak. It is also called Chadlock, Wild Mustard, Corn-calc. Blossom yellow, and without veins. Root annual; flowering in May.

Sinapis nigra. Pods rough, laid flat on the spike stalk. Blossom pale yellow; pods slightly hairy. Root annual; flowering in June.

Raphanus raphanistrum. Calyx upright, close; pods round, jointed, smooth, of one or two cells. Blossom varying in colour from yellow to straw and white, striped with purple veins. Root annual; flowering in June and July.



Sinapis nigra.
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Sinapis arvensis.
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Brassica napus, has the root a regular continuation of the stem. Blossom yellow; pod with warty excrescences. Root biennial; flowering in May.

2. CORN POPPY (*papaver rhæas*). Indifferently called Red-poppy, Corn-rose, Cop-rose, Head-wark, Red-weed, Red-maikes. Capsules oblong, smooth; stem many-flowered; fruit-stalks with bristles laid to; leaves wing-cleft, snipt. Root annual; flowering in May.
3. BLUE BOTTLE (*centaurea cyanus*). Also named Knap-weed, Corn-flower, Hurt-sickle. Anthodium with serrated scales; leaves strap-shaped, very entire; the lower ones toothed. Root annual; flowering in June and July.
4. MAYWEED, or Mather, or Stinking Camomile (*anthemis cotula*). Receptacles conical; chaff bristle-shaped; seeds naked.
5. CORN MARIGOLD (*chrysanthemum segetum*). In Scotland, this is called Yellow Gowans, Quills, Gools; in Kent, Yellow Bottle; in Norfolk, Buddle; midland counties, Golds, Goulds, Gowls; north of England, Gowlans, Goldens, Gules. Leaves embracing the stem, jagged upwards, tooth-serrated towards the base. Root annual; flowering from June to October.

Linnæus says, this weed was imported into Sweden, along with corn from Jutland, about the end of the last century, and that there is a law in Denmark to oblige the farmers to extirpate it. He recommends the land to be manured in autumn, summer-fallowed, and harrowed frequently after ploughing.

The above class of weeds, with their gaudy colours, like heralds of spring and summer, proclaim bad farming to the landlord, the tenant, and to the passenger; and announce the neglect of using clean seed-corn, judicious manuring, fallowing, the row culture, and horse-hoe husbandry.

It is true, however, that certain constituted soils are more obnoxious to particular kinds of weeds than to others; and, *vice versa*, also that the same proportion of labour, skill, and attention, which, when employed, shall keep clean and in good heart one kind of soil, shall not be found adequate to produce the same effects of clean and perfect husbandry on another soil differently constituted, but that increased precaution and industry are required to produce the same effects. Precaution here is of great importance, for if the seed-corn be not clean, the crop will be foul, whatever care may have been employed on the land; on the other hand, should the land itself be clean, and the seed-corn likewise, yet, if the hedge-rows are neglected, and suffered to harbour these weeds, the evil will be found only lessened in a degree, not removed.

To extirpate these weeds, therefore, clean corn-seed must be used, not a single plant of these weeds suffered to perfect seed in the hedge-rows, and a judicious rotation of crops adopted, so as to admit of the unsparing use of the horse-hoe, as well as of the hand in weeding; by which means, these noxious and disgraceful pests of corn-fields will be overcome, and banished from the soil.

The corn-poppy particularly accumulates upon gravelly soils of low quality, also on dry sandy soils, and generally on all dry and shallow lands which are over-cropped and neglected. But much better soils, as loamy gravel, &c. are infested with it, only here the crops are generally good enough to keep it under; and being less abundant, it is much easier subdued by weeding. But the corn-poppy is never so triumphant as in a hot and dry season, in which case, many fields, which should have been corn, are wholly covered with it. The misfortune, and that which is borne with wonderful patience by old-fashioned farmers, is, that such a prodigious increase of seeds is added to the soil with every crop. It seems astonishing that the farmers do not think it time now to begin to destroy, rather than propagate them. But they probably reflect that the land is as full of seeds as it can be, or that a bigger crop of the weeds than

they frequently get, can by no means grow. This may be very likely, but it is not the way to any remedy or improvement on soils so infested.

One of three things must be done by way of remedy : 1st, the soil must be clayed or marled ; 2d, or it must be fed with much larger quantities of farm-yard dung or compost : 3d, if neither of these be easily practicable, *the rotation must be changed*. I have known a farmer, who occupied a gravelly loam quite good enough with good management to bear the *four-course shift* — to pop in a stolen crop of barley between his wheat and the next turnips : nothing can excuse this conduct, as it must necessarily encourage weeds, and hurt the other crops. But the change of rotations must extend to greater alterations than such as this. It is totally useless to continue a course which will not pay the expenses ; and therefore, instead of saying, “ Fallow your land better ; hoe your turnips clean (if you get any) ; drill your barley, and leave not a weed in it ; ” though all these are highly important where the soil will pay you for the working, yet where it will not, after the above course once over, sow good grass-seeds, or sainfoin, to lie for a period of years. This will narrow your ploughed land, and strengthen you in manure ; so that improvement may be looked for on the rest of the farm.

When such land comes up again, it must be autumn ploughed, and go to turnips ; then barley and seeds again for two years ; when it comes up again, autumn ploughed, it will probably bear peas (well cleaned), then turnips, barley, and seeds two years ; and soon, if any one pleases to ask, “ Where must we grow wheat ? ” it may be answered, that probably some pieces on the same farm may bear a better rotation ; but at any rate, land of the nature above described can but very rarely be fit for such a crop.

When the four-course shift became general, it seemed difficult to think of any other mode, after clover, but wheat ; almost all newly enclosed lands, which had been for ages in open fields, would bear clover at first, and generally good ; they therefore sowed wheat after, and got pretty crops ; but this would not last : and thus the four-course shift has been

much too general, and much too long persisted in, on such light soils.

Land of too low a quality for wheat after one year's seeds, is but poor land; but the breadth of it is very considerable in the kingdom. After laying two years in seeds, some try a naked fallow for wheat; but all their manure is wanted for turnips, and these wheat crops are generally very thin and short. Mr. Coke, of Holkham, after two years' lay, autumn ploughs, and gets the tilth ready for peas, drilled at 18 inches; after the peas, he drills wheat with *rape cake*, and gets (or did get) good crops. But I should think that this system is now at an end; the present art of farming is to do all that the soil will allow—but spare the pocket.

To the foregoing very good advice, where it can be followed, it is necessary to add a few practical observations, which may be of use to those unacquainted with the natural history of some of the annual weeds above named.

It is well known that the seeds of charlock, poppy, and camomile, lie for ages in the bowels of the earth uninjured; and it is only when brought near the surface, that they can be made to vegetate, and *then only* under peculiar circumstances of the surface soil in which they lie. It has long been observed, that the prevalence of charlock and poppy occur periodically. In one year every field will have an abundant share of one or both of these weeds: and it sometimes happens, that for ten years at a stretch, neither will appear in any injurious quantity. Hence the old saying, “it is a charlock year,” or it is “a red-weed year.” Showing that their appearance does not so much depend on the quantity of seed in the ground, as on the favourable state and condition of the soil, when it is sown with corn.

Old farmers must have been very unobservant indeed, if they had not been able to assign a good reason for this periodical appearance of the weeds in question. But this is not the case: a good experienced farmer will tell you, that, if he were to lay in his wheat in a dry time, in a loose friable soil, and leave it so to take its chance, he can with certainty predict that his wheat will be overrun with the above, and other annual weeds, in the following summer. To prevent

this ruinous result, he therefore takes care that the loose surface be well consolidated (if rain does not fall to do this), either by a heavy roller, or, what is better, treading it firmly down with sheep, till the whole surface is as compact as a foot-path.

When wheat is laid in, as it should be, rather heavy, there may be no necessity for either rolling or treading; neither need fears be entertained, that seed weeds will rise plentifully in the following summer: but if laid in a loose pulverized surface, the poppy and charlock will certainly prevail, even if no such weeds have been seen in the same field for years before.

Almost all other kinds of corn affect a well-compacted surface; and the business of rolling has other advantages besides obtaining a smooth surface for facilitating the action of the scythe.

CHAPTER IV.

OF THE WEEDS CALLED UNDERLINGS, OR SUCH AS NEVER RISE IN THE CROP, NOR COME INTO THE SICKLE: WITH OBSERVATIONS ON PASTURE WEEDS.

1. GROUNDSEL, Simson (*senecio vulgaris*). Leaves winged-indentcd, embracing the stem; flowers scattered. Root annual; flowering from March to December
2. ANNUAL MEADOW-GRASS, Suffolk-grass (*poa annua*). Panicle divaricate; spikelets ovate, five-flowered; florets somewhat remote, five-ribbed, without a web; culms oblique, compressed.
3. CHICKWEED (*stellaria media*), or Common Stitchwort. Leaves ovate; stems procumbent, with a hairy alternate line on one side; stamens from five to ten. Root annual; flowering from March to December, and generally upon the richest land.
4. SHEPHERD'S PURSE (*capsella bursa pastoris*). Pouches compressed, triangularly inversely heart-shaped, smooth, without a border; root-leaves wing-cleft. Root annual; flowering from March to September.
5. SPURRY (*spergula arvensis*)*. Leaves whorled; stalks when in fruit reflexed. Root annual; flowering in June and July.

* There is a larger-growing variety of common spurry, called *spergula sativa*, which is cultivated in some parts of Germany, for sheep,

6. CAMOMILE FEVERFEW (*matricaria chamomilla*).

Receptacles conical ; rays expanding ; calyx scales equal at the edge. Root annual ; flowering from May till August.

7. FAT HEN, Lamb's Quarters, Wild Spinach, Mountain Spinach (*chenopodium album*). Leaves rhomboid-ovate, jagged, mealy, entire towards the base, upper ones oblong-entire ; seed quite smooth. To which might be added, May-weed ; but as it frequently rises into the sickle, it has been entered under the head of Rampant Weeds.8. COMMON CORN SALAD, or Lamb's Lettuce (*fedia*

but chiefly for reclaiming waste, barren sands. Mr. James Booth, of the Plotbeck Nurseries, Hamburg, informs me, that its effects in this last respect are found to be highly beneficial. This may probably be accounted for as follows :— The plant is an annual of rapid growth, and derives its chief nourishment from the air ; it is consequently very succulent, affording but little vegetable fibre in proportion to its contained juices. It will grow on sands, where scarcely any other plant will vegetate. Its growth is so quick as to afford two or three crops in the season. Sheep are stated to be fond of it. When the plants are full grown, which will sometimes happen in four or five weeks from the time of sowing, particularly if sown after the warm weather commences, the plants may be ploughed in, and another crop of seed sown ; when the plants are again full grown, let the process be repeated. But should the sand produce the plants sufficiently large to afford a regular bite to sheep, then depasturing will be found most beneficial. In this last case, the sand must be ploughed after the sheep have eaten down the spurry ; and by fresh crops, depasturing, and ploughing in, the soil will soon be so far improved, as to carry the permanent grasses adapted for light soils. The sand will then bear permanent depasturing ; it will be consolidated by the feet of the sheep, and this, with the manure supplied by the sheep, will by degrees perfect a sheep-down. In order that the proprietors, in this country, of the above description of waste sands, might have an opportunity of trying the effects of the *spergula sativa*, as above mentioned, a supply of the seed from Germany is obtained, and may now be had of Messrs. Cormack and Co., Nurserymen, New Cross, near London.

olitoria). Leaves linear, tongue-shaped, blunt; flowers capitate; capsule inflated, two-lobed. Root annual; flowering in April and June.

Professor Martyn observes, that the common English name of this weed probably had its origin from the circumstance of the plants appearing in flower about the time that lambs are dropped. In the English Flora, Sir J. E. Smith has happily separated this plant from *valeriana*, and has thereby lessened the labour and removed the doubts of the young botanist, which always presented themselves when the botanical characters of this plant came to be compared with those mentioned in the generic character of *valeriana*. The name *fedia*, Sir James Smith observes, as derived from *fedus*, an ancient word, synonymous with *hædus*, a kid, is not unsuitable to this genus. As judicious husbandry will render harmless this humble intruder on tillage lands, I shall just observe, that a small bed of rich garden earth sown with the seeds in August, or in the end of July, will supply an excellent portion of salad throughout the winter, until April*.

9. FLIX-WEED (*sisymbrium Sophia*). Petals smaller than the calyx; leaves finely divided, somewhat hairy. Root annual; flowering in June and July.

This is more prevalent on dunghills and rubbish heaps than in corn fields. It ripens its seeds in August and September. The pods retain the seeds all winter. The force of gunpowder is said (with what certainty I know not) to be augmented by mixing a tenth part of the seeds of flix-weed with the other ingredients.

* It has been long known and used as a salad herb, and lately as an excellent vegetable dish for the table, dressed in the manner of spinach. If sown as above mentioned, the plants will be ready for use when the summer salads are over. I may here be permitted to add, that water-cresses (*sisymbrium nasturtium*) have lately also been found to afford a salubrious vegetable dish, when dressed in like manner, particularly for invalids.

10. COMMON FUMITORY (*fumaria officinalis*). Pericarps one-seeded, racemed; stem diffuse. Root annual; flowering all the summer.

This is a very common weed on certain light, sandy soils; it indicates the want of manure, and the neglect of the drill or row mode of culture. Although cattle and sheep are said to eat it, yet I never could observe, in the course of my experience, any disposition in these animals to touch the plant.

11. SAND MUSTARD, Isle of Thanet Stinkweed (*sinapis muralis*). Pods ascending on spreading stalks, linear, compressed, slightly beaked; seeds two-ranked; leaves sinuated; stems roughish, with reflexed bristles.

Since the above was sent to the press, we had an opportunity of observing this troublesome weed in the Isle of Thanet, to which it seems to be confined. An experienced agriculturist and extensive farmer (I. A. Champion, Esq. of Sarr) informs us, that about twenty years since he remembers seeing this weed at Broadstairs, where it was then chiefly confined to the margins of lands lying nearest to the beach. It was said that a vessel laden with corn had been cast away on that part of the coast, and that this noxious weed had been by that means introduced into the Isle of Thanet. Since the time above mentioned, it has overrun the arable land all over the Isle.

Mr. Pitt, in the Introduction to his Essay on Weeds, informs us, that where weeds cover the surface, there is no room for corn; and that where they abound and contend with the corn, they take up the nourishment which the corn should have; and lastly, if weeds be not destroyed, they spoil the crops, and deteriorate the soil. With regard to the identity of the *nourishment* absorbed by corn and by weeds, there may be some doubt, as it appears by continual experience, that you need only plough and pulverize to have crops of weeds for ever. It is not so with corn. And moreover it is equally certain, that poor soils, and those over-cropped, abound with weeds much more than the same soils

well cultivated, where useful crops of corn are obtained. This dispute is scarcely worth maintaining; but I believe that weeds do much more harm by excluding the light, and so choking the corn, than by the nourishment they absorb. This may be allowed to be demonstrated in the case of young quick hedges. These plants strike downwards, and bring their sustenance very much from below the soil; yet if weeds be suffered to overgrow them annually, they are much injured, and stunted in their growth. In the early part of the growth of corn, let us consider how essential are the functions of the leaves; and for some time after the corn shoots up, the side leaves ought to feel the full effects of light and air; but if weeds interfere, and fill all the intervals that should be, and press upon the crop (growing faster, as some of them do), the crop is deprived not only of nourishment at the root, but of the healthy communication of atmospheric influences with the soil and the plants. It is no answer to say, that *the weeds thrive notwithstanding*; we are speaking of comparatively tender and valuable plants, which are the objects of necessary and expensive cultivation.

But by whatsoever means the weeds effect the mischief complained of, it is equally necessary to destroy them. Mr. Pitt, in making a few observations on the corn-poppy, observes, that "abundance of it is a pretty sure indication of a light crop." Upon which he raises this query: "Is the lightness of the crop occasioned by the abundance of this plant, or the increase of this plant encouraged by the lightness of the crop?" To which profound doubt he gives a very careful and ingenious answer: "*Probably both.*" He forgets, however, the rule with which he sets out, "that where weeds cover the surface there can be no room for corn." But the truth of this matter is, that he takes no notice of soil, nor makes any allusion to the effects of season. Weeds peculiar to gravelly and dry soil, as corn-poppy, blue-bottles, may-weed, and corn-marigold (among the list of rampant weeds), as well as corn-bindweed, &c. among fallow-weeds—feel no effect from drought. The hottest seasons are congenial to them; but the crops of wheat or barley, and sometimes peas likewise, are burnt up at the

root by the beginning of July, and thus have gradually, from the commencement of the drought, left the surface to the full occupation of the weeds which prevail. The farmers see that they have no probable interest in resisting this prevalence; and no implement but the scythe or the plough could intercept it. Thus, in hot seasons, and on shallow soils, we see these weeds very numerous in many places, and the crops worth very little; but had the season been wet at the time the corn was sown, the crops would have kept ahead.

I should be sorry if by this explanation it were understood, that this condition of the soil, so full of seeds, and so liable to produce excess of weeds, were at all defended. I have seen such a piece of poor, sandy gravel in Holkham Park, in the hot year of 1818, with a light crop of peas (as it must be), but scarcely more than five plants an acre of corn-poppy; whereas, before Mr. Coke took it under his own management, it was annually covered with them. In the same Park, I have crossed diagonally over a piece of wheat, measuring forty acres, and found but three plants of cockle, without seeing any other weed. Certainly you cannot have good crops where you are liable to smothering weeds; the very existence of the weeds shows bad management. In fact, I have seen the poorer convertible land tilled until it would bring no crop, and grass seeds are thrown upon it with the last attempt to get barley. For several years after, it has been perfectly covered with may-weed and other weeds, such as underlings, &c.

Land may be rendered inert and unfertile from an excess of manure, as well as from the want of it, severe and avaricious annual cropping long persevered in being understood in both cases. Over-stimulus, as in the first instance, wears out, or renders inert, the principle of fertility in the land; and in the latter instance, the want of stimulus produces the same effect. The underling weeds above mentioned flourish and prosper under this state of the land, brought on by either cause. The remedy is therefore obvious, *viz.* rest; or, give a clear-out summer fallow, and if in the first-mentioned case (which is to be met with in deep fen land and in

old garden mould), apply a good dressing of lime, and sow down with the superior pasture-grasses and clovers, to remain for not less than five years. In the latter case, or where the fertility of the soil is worn out by injudicious cropping and a niggardly supply of manure, joined to the naturally thin and poor staple of the soil, then a full application of manure, or marl and manure, the latter consisting as much as possible of cow-dung, should be given, and the latter sown down with the superior permanent pasture-grasses suited to the soil, with a due admixture of clover.

OF PASTURE WEEDS.

THE most noxious weeds which infest grass lands or pastures, have already been alluded to under various heads; we shall here, therefore, enter less into detail.

1. DWARF-THISTLE, Stemless Thistle (*carduus acaulis*.)
2. COMMON CAMOMILE (*anthemis nobilis*).
3. STAR THISTLE (*centaurea calcitrapa*).
4. OX-EYE DAISY, Maudlin Wort (*chrysanthemum leucanthemum*).
5. GREAT FLEABANE, Ploughman's Spikenard (*conzya squarrosa*).
6. CHEESE RENNING, Yellow Ladies' Bedstraw, Petty Muguet (*galium verum*).
7. LONG-ROOTED HAWK-WEED.
8. WILD THYME, Mother-of-Thyme (*thymus serpyllum*).



Carduus arvensis.

P. 37.



Carduus acanthoides.

P. 37.

9. SHEEP'S SORREL, or Dock (*rumex acetosella*).
10. KNOT-GRASS, Snake-weed, Red-weed (*polygonum aviculare*). This has already been noticed under the head of "Fallow Weeds."
11. YELLOW RATTLE, or Cock's-comb, Cock-grass, Penny-weed, Heny Penny, &c. (*rhinanthus crista galli*).
12. COMMON CARLINE THISTLE (*carlina vulgaris*).

The above are more frequently found to infest dry, sandy pastures and calcareous soils, than loamy or damp grass lands. Where they prevail to a great extent, there is no remedy like breaking up the land, and taking a course of crops, for palliative remedies are of little avail. The thistles, sheep's-sorrel, and knot-grass, are the most formidable. Hand-weeding, when the weeds are confined to local spots, and are only just beginning to spread generally over the soil, will be found effectual; but when once the pasture becomes generally infected with the seeds and roots of these plants, no time should be lost in using the plough, harrow, and horse-hoe, and a judicious course of cleansing crops before returning the land again to permanent pasture.

Pasture weeds which generally prevail in loamy soils, and such also as are prevalent in clayey and damp soils are principally as follow.

1. YELLOW GOAT'S-BEARD (*tragapogon pratensis*).
2. MARSH-THISTLE, or Red Thistle (*carduus palustris*).
This is almost confined to wet, damp pastures.
3. MELANCHOLY THISTLE (*carduus heterophyllus*).
4. MEADOW-THISTLE, or Small Purple Thistle (*carduus pratensis*).

5. COMMON BUTTER-BUR, or Pestilent-Wort (*tussilago petasites*). Moist meadows.
6. COMMON RAGWORT, Ragweed, Staggerwort, St. James's Wort, Seggrum, Scotch Canker-weed, Stinking Elshinder, &c. &c. (*senecio Jacobææ*).
7. COMMON DAISY, Bairn Warts, &c. (*bellis perennis*).
8. COMMON BLACK KNAP-WEED, Black Mat-Fellow, Bull-weed, Cock-Heads, &c. (*centaurea nigra*). It is said that horses are particularly fond of the hay of which this plant forms a part.
9. BROAD-LEAVED DOCK (*rumex obtusifolius*).
10. ORCHIS. Of this weed there are several species, viz. *Orchis mascula*, *orchis maculata*. These two orchises furnish the tubers for the manufacture of salep. *Orchis latifolia*, *orchis morio*, *orchis pyramidalis*: they are chiefly confined to damp pastures that require draining. Man-orchis, red-lead, and frog-wort, are the only English names we have heard given to these weeds in damp pastures, where they are but little formidable. In the flower garden they are considered interesting ornaments.
11. COMMON COW-PARSNIP, Hog-weed (*heracleum sphondylium*). Leaves pinnate; leaflets pinnatifid, cut, and serrated. This very large and cumbrous plant usurps a large share of the surface of moist meadows, and sheds abundance of seeds. It is checked by grazing late in the spring with sheep.
12. SEDGE (*carex*). This is a numerous family of coarse, grass-like plants, chiefly confined to damp, sour soils; they are innutritious, and but seldom or ever touched by cattle. To enumerate all the different species of this genus, of which there are upwards of fifty, would here be of little or no utility. The essential family, or

generic character, is as follows: Flowers unisexual, imbricated: calyx of one leaf; corolla wanting. Female flowers with an inflated three-toothed nectary; stigmas three; seed three-sided, enclosed in the nectary. The flowers, or the seed, will at once enable the farmer to distinguish every species of sedge from the true or proper grasses.

We once examined a sample of meadow hay said to possess very fattening properties, in which was found an inconsiderable quantity of the *carex incurva*, but the superior permanent pasture grasses constituted the bulk of the hay: it also contained a considerable portion of burnet (*poterium sanguisorba*). The warm or stimulant nature of the burnet as a winter food, combined with turnips, will readily account for the superiority of this hay, without the agency of the curved-leaved sedge, which was here in too small a quantity to affect the quality of the hay either way.

To the above list of pasture weeds many other plants could be added, if any good were likely to result from their being enumerated here; but as they are only occasionally found, and the foregoing being destroyed or eradicated out of pastures, these will be found harmless,—we shall therefore pass them over. In the low flat lands bordering on the Isle of Thanet, a very noxious weed infests some of these valuable pastures: this weed they call spurt-grass. It is the *scirpus maritimus*, or salt marsh club-rush.

The means to be adopted for the extirpation of these noxious weeds in pastures, must be regulated by the nature of the soil, and the comparative prevalence of the weeds. In good pasture land, where, from accident or neglect, these weeds in part have insinuated themselves, hand-weeding may most advantageously be had recourse to; and particularly for the larger weeds, such as thistles, rag-weed, docks, and knap-weed, it will be found the best temporary remedy. Should the coarseness of the pasture have been occasioned by too frequent *haying*, then depasturing closely for two or three years, with a good top-dressing of dung-compost applied in the early part of the spring, or late in the autumn, with strict attention to hand-weeding, will be found effectual to recover the pasture and extirpate the

weeds. We have witnessed pasture land of the best quality brought to produce little else than the coarse grasses, from having been kept for a series of years under the scythe for hay; and, at the same time, land of the same quality, separated only by a fence from the former, producing the richest quality of herbage from being regularly depastured. On poorer soils, however, the bad effects of too close feeding were evident, — daisies, procumbent trefoil, mosses, and annual meadow-grass, prevailed over the superior grasses of the pasture. On this kind of soil, moderate depasturing, and a crop of hay in two or three years, had the effect of encouraging the superior grasses to overcome these dwarf unproductive plants. Frequent top-dressings are of the greatest use in effecting the above improvements on deteriorated thin pasture lands, as regards the destruction of weeds, as well as of improving the quality of the pasture.

In crops of artificial grasses, such as sainfoin, lucern, &c., when the dwarf thistle prevails, and when it is impracticable under such circumstances to draw out this weed without injuring the crops, a good remedy will be found in the use of common salt. An enlightened agriculturist, T. B. Evans, Jun. Esq., informs us, and authorizes us to state the fact, that common salt dropped on the crown of this weed effectually destroys it, without injury to the crop of grasses. Children may be employed to apply the salt by the hand to the weeds; and, when we consider how much more expeditiously and safely this remedy may be used on crops of sainfoin, lucern, and clover, in comparison to that of pulling the weeds up by the roots, it is, doubtless, a valuable discovery. When the sedges, marsh thistle, pestilent wort, &c. prevail in meadows, then recourse must be had to other means than that of hand-weeding, *viz.* draining, paring and burning, liming, and a judicious rotation of crops under the horse-hoe husbandry, until every vestige of the seeds and roots of these noxious weeds disappear. The ground may then be laid down to permanent pasture, with the seeds of the most valuable species adapted to the soil, and where water can be commanded, converted to water-meadow, by which the value of the land will be considerably increased.

The names and quantities of the best grasses recommended by Mr. Sinclair are mentioned at pp. 176, 177, &c., and seeds of the following kinds are cultivated, and may be had of Messrs. Thomas Gibbs and Co., Half-Moon Street, Piccadilly, London, *viz.*

Agrostis caninum.
Agrostis stolonifera.
Alopecurus pratensis.
Anthoxanthum odoratum.
Avena flavescens.
Avena pratensis.
Briza media.
Bromus arvensis.
Cow-grass.
Cynosurus cristatus.
Dactylis glomerata.
Festuca Cambrica.
Festuca duriuscula.
Festuca fluitans.
Festuca glabra.
Festuca heterophylla.
Festuca hordeiformis.
Festuca ovina.
Festuca pratensis.
Festuca rubra.

Festuca sylvatica.
Festuca tenuifolia.
Holcus avenaceus.
Holcus lanatus.
Hordeum pratensis.
Lolium perenne.
Perennial Red Clover.
Phleum pratensis.
Poa annua.
Poa cœrulea.
Poa fertilis.
Poa nemoralis.
Poa nervata.
Poa pratensis.
Poa trivialis.
Red suckling.
Rib-grass.
Trefoil.
White or Dutch Clover.
Yarrow.

APPENDIX.

*Some Account of an effectual Mode of Cleansing heavy Lands infested in a high degree with Fallow-weeds, particularly with Couch-grass (*Agropyrum repens*), without the aid of Naked Fallow; as practised by Mr. R. DICKSON, of Kidbrook, Blackheath. — By the EDITOR.*

THE triumph of skill and perseverance over that powerful enemy to good husbandry on tenacious, damp soils, *viz.* the worst of fallow weeds, — *couch*, we believe was never more satisfactorily demonstrated than by Mr. Robert Dickson, on his farms at Kidbrook, Blackheath. The soil of this part of his farm, to which the following observations are confined, so overcome with couch-grass, is a strong, tenacious clay, and in some parts approaching to cementing gravel. Large portions of the land, when Mr. Dickson entered on the lease, were extremely foul with fallow-weeds, particularly couch-grass. The rent being high, to have attempted the cleansing of all this land by the only known means of naked fallows, or more expensive process of forking out, would have been attended with great loss, if not with ruinous consequences. We shall here content ourselves with stating what we have witnessed of this very excellent practice, referring our readers to a view of Kidbrook farm for full demonstrative evidence of the merits of this valuable practice.

A field, containing 83 acres of the nature and condition above described, came into Mr. Dickson's hands at Christmas last; the previous crop had been potatoes and white crops; two ploughings and harrowings had been given after the white crop was taken, and the land raised up to be ameliorated by the winter frosts. In the month of April

following, when we first saw the field, its surface could not be distinguished from the adjoining pastures, so matted, full, and chain-bound with couch-grass, was this tenacious, obdurate soil. By a series of combined operations, with implements accurately adapted for the purpose, partly new, and partly improved by himself, Mr. Dickson accomplished in a few days all the effects of a clear-out summer naked fallow, without the loss of time and crop always attending on this hitherto unavoidable operation for cleansing neglected couch-bound land. It is well known that strong lands cannot be cleaned for a turnip crop the same season. In one day the same land is ploughed, cleaned, manured, and planted with potatoes; and by the judicious use of his hoeing implements and rotation of crops*, Mr. Dickson completely keeps down and suppresses any attempt of the couch to gain possession, until its enfeebled roots give way altogether to the ordinary mode of culture.

The implements required to effect the above important objects on a strong, tenacious soil, are,

1st. Hally's plough.

2d. Morton's revolving harrow (invented and made by that ingenious mechanic, Mr. Morton, of Leith), as improved by Mr. Dickson. This powerful and effective implement is so contrived as to allow the horses to walk in the furrows.

3d. Improved drag-harrow, by Mr. Dickson, in four parts for corn, eight feet land. This is also constructed in such a manner as to allow of the full and complete working of the harrow while the horses walk in the furrows, thereby saving their feet when the soil is dry, and composed of hardened lumps on the surface; or, when *green*, prevents the serious injury occasioned by poaching with the horses' feet.

4th. A heavy cast-iron cylinder roll, in two parts, with an improved knife for cleaning it when working.*

* The Kidbrook farm consists of 620 acres; viz. wheat 100, tares 60, potatoes 60, beans 30, oats 40, barley 30, clover 100, meadow 170. But the rotation varies according to circumstances connected with green crops raised for market. The breadth of potatoes every year allows of the above practice, saving so much naked fallow every season.

5th. New improved drill grubber. This implement is constructed so as to accommodate itself to every breadth of the drill husbandry, as regards green fallow crops, such as turnips, potatoes, beans, peas, &c. : it will work in any soil, however dry and stiff.

6th. Improved grubber for pulverizing and broad sharing: by means of three coulter, which are readily affixed to the implement, it acts as a broad sharer.

This last-mentioned implement is one of great merit and utility, it produces a friable surface-soil, for moulding up and for encouraging the growth of the plants, which, on *cementing*, heavy, *obdurate* soils, cannot be effected by any other implement yet invented.

We shall now endeavour to state, in as few words as possible, the mode of using these implements, as practised by Mr. Dickson, to produce the above-mentioned important practical results, and which we had an opportunity of witnessing.

Hally's plough is used in the first operation; this is followed by Morton's revolving harrow: the effect of this implement is astonishing in separating and breaking down the tenacious couch-bound soil, and shaking out the roots. As before observed, this implement is so constructed, as to allow of the horses walking in the furrows, —a point of the greatest importance in working a soil of this nature, whether it happen at the time to be in a dry or in a damp state. The couch being now loosened from the soil, the improved drag-harrows are applied to collect it; this they appear to do in a more effectual and expeditious manner than any other kind of harrow we have seen. When this operation is finished, a heavy cast-iron roller is used, to level the surface for spreading the manure; the roller is furnished with a knife, so constructed or applied, as to keep the surface of the roller always clean when working. The surface being thus levelled, and the manure spread, the last ploughing is given; the potatoes are either planted in the furrow, or afterwards dibbled in, according as circumstances or convenience may direct. It is hardly possible to witness these operations of good husbandry (required, as they are, im-

ratively, under such circumstances of soil as above mentioned), without feeling a high gratification.

At this time, June 27, the crop of potatoes so planted looks remarkably well, the land being comparatively clean, and the plants healthy, although the season has been very unfavourable for this description of land, which in dry weather becomes so indurated, as to resemble in some degree a solid mass of stone.

As soon as the plants appear above ground in the rows, the drill-grubber, before mentioned, is used to clean and loosen the soil. As this excellent implement is constructed so as to accommodate itself to any breadth of the drill husbandry with respect to green crops, it may be used for the bean, pea, and turnip crop, as well as for potatoes; on the most tenacious clay it produces a friable surface-soil for moulding up, it effectually reaches the couch, and by its effects in loosening and breaking the hardened soil, greatly benefits the health of the plants. Wheat crops in Kent, Surrey, and Essex, have severely suffered this season from the slug; salt and other topical remedies have been tried, but without the *least perceptible* beneficial effect. This crop, after clover, tares, and beans, has failed this season at least one-third. In wet seasons, the slug propagates with such rapidity, that a wheat crop, after these green crops, is very uncertain, and may be said always to fail. Mr. Dickson has happily adopted a practice which is found to be effectual, in preserving and securing the wheat crop under such circumstances. The following are the principles on which this valuable practice is founded:—The slug, as before observed, prospers under favour of the wet season; the clover, beans, and tares, afford the very best possible shelter and food for this destructive enemy to the wheat crop. At the end of autumn, when the plough is put into the ley, myriads of the slug, in its various stages of life, from the egg to the full grown devourer, lying near to, and on the surface of the land, are by the ordinary practice of deep ploughing, placed below, and out of the reach of harm, until spring, or favourable open weather during winter, encourages them to come

out. But, instead of the autumn deep ploughing, as ordinarily practised, Mr. Dickson ploughs at first only from two to three inches deep; if the land is on the flat, he uses his grubber and scarifier, which cuts to the depth of from two to three inches, and $4\frac{1}{2}$ feet wide, and which performs the work exactly of five ploughs. The eggs of the slug are here brought to the surface, and exposed to the effects of the sun and air, which, as far as regards the eggs, is completely effective in causing their destruction, as well as in lessening the number of the perfect slugs. This accomplished, the usual depth of ploughing is given at the proper season. Two pieces of wheat on the same field exemplified this in a striking degree this season; the crop of the one, which had been treated according to the common practice of first deep autumn-ploughing, had to be ploughed up in the spring, as scarcely a single plant of wheat was left by the slug, although the young plants at first were strong and healthy. On the other piece of wheat, which had been treated as above, the crop was full and excellent.

Since the above was sent to the press, I was much gratified to receive the following information from an enlightened agriculturist (Thomas Neames, Esq. of Chislet). Last season Mr. Neames had a large ley field; a portion of the ley he scarified, or broke and stirred the surface until the surface plants were all destroyed, or nearly so. The other portion of the ley was ploughed in the ordinary manner; the scarified portion was also now ploughed, and treated in the usual way for wheat. In the spring, the scarified piece was scarcely deficient of a plant, and the crop proved an average one; while the other portion of the field, which was treated in the usual way, had nearly the whole crop destroyed by the slug; which very frequently happens, if the farmer neglects to dust the clover stubble with lime; or does not use a presser to consolidate the surface, to prevent the motions of the slug.

It seems clear, therefore, that all the surface plants of the ley should be completely destroyed by scarifying and

harrowing, or by shallow ploughing and harrowing. By these means the slugs and their eggs are destroyed, as well as the food which would have supported them until the wheat plants were fit for their ravages.

Facts such as these, on a subject of so much practical importance as this, are highly pleasing, for they afford proofs at once clear and satisfactory, and beyond the reach of doubt.

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